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UNIVERSITY OF ALBERTA

Idiosyncratic Stress Responses in Search and Rescue Technicians

by

Gordon Meyer

(C)

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND RESEARCH

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE

OF Master of Science

Department of Physical Education and Sports Studies

EDMONTON, ALBERTA

Spring, 1991

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ISBN 0-315-66591-2

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled Idiosyncratic Stress Responses in Search and Rescue Technicians submitted by Gordon Meyer in partial fulfilment of the requirements for the degree of Master of Science.

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Supervisor

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Date: Jan. 13, 1991

DEDICATION

To my parents and friends who weren't quite sure, but were there.

ABSTRACT

The nature of stress research has dictated the necessity of moving laboratory practises into real life settings. Continuous monitoring of three Search and Rescue Technicians (SARTechs) during the course of an entire day provided respiratory, cardiovascular and psychological baselines and data on the subjects' responses to three different situations. A descriptive and visually comparative analysis was performed on the data in order to determine if potentially pathogenic responses were elicited, and, how the various forms of the data may interact to result in the overall response. The analysis revealed that each subject responded in a similar manner, supporting the contention of the universality of a stress response, but, the pattern of the response was individual. Comparison of the data to that obtained from subjects with pathological breathing patterns(Tobin et al,1983) was performed to determine whether a pathological pattern was elicited in each of the situations. The wealth of information provided by continuous monitoring needs to be exploited in order to obtain a comprehensive picture of an individual's adaptation to changes in the environment.

ACKNOWLEDGEMENTS

To Sgt. Gallagher and the rest of the instructors at the Survival School for their insight and stories about SARTech life.

The SARTech Class of 1989 for participating as subjects.

Dr. G. Mann for so generously donating the equipment and his technician.

Tom, the technician, who ensured everything was put together right and ran.

To my commitee members, for making the whole process enjoyable.

Gunga Din, for getting me interested.

Lastly, The Guru, for making things clear and then muddying up the water again.

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Chapter I

STATEMENT OF THE PROBLEM

A. Introduction

We live in a world obsessed with certainty. Questions are asked in order to explain phenomena and predict the impact an event or occurence will have; at a microscopic level or at a global level. Concepts can explain the phenomena with a certain degree of precision, which borders on being factual. One such concept is stress. The effects of, and, the variables influencing stress are scrutinized at the cellular level of living organisms and at global levels.

The adaptations which occur in response to the interaction between the environment and organism are difficult to predict with any degree of accuracy. The growing concern of chronic health problems has implicated stress as a primary catalyst in the transition of an individual from a healthy state to one of disease. The dilemma of identifying the role of stress in disease development extends beyond diagnosing the presence of high blood pressure, or, isolating the stressors which exist in a person's work and family life. Because of the complexity of the human mind and its ability to create, there is a need to understand how an individual understands or perceives the environment. Beyond addressing the perceptual content, identifying how the person copes is also of vital concern. The coping strategies employed provide a person with further information about how well a problem has been dealt with, thereby creating a new situation; a solution or different insight to the problem, or, propogation of the existing information.

By addressing and accepting the large number of variables which influence an individual's response to a stimulus, the apparent spuriousness of the existing psychological and physiological literature on the subject becomes more meaningful. To begin to understand how an individual responds to a situation, physiological recording of systemic reactions is one step to take. Phenomenology of the experience must also be explored to gain insight into how the individual felt during the situation and how the demands were dealt with.

Elucidation of an individual's response to stress will occur only if the aforementioned variables are considered wholistically. If a person was exposed to a set of circumstances which were subjectively reported as stressful and the physiological indicators did not demonstrate likewise, or if a reciprocal relationship existed, there would still be uncertainty as to whether or not the situation was actually stressful but some insight into how stress is manifest in a given subject would become more evident.

Response specificity, dependent on the individual and the environment, was documented by Lacey (1967) who coined the phrase *individual response stereotypy*. Inconsistencies in the predicted physiological responses of different individuals to the same stimulus, and, of the same individual to different stimuli questioned the universality of the stress response as postulated by Walter Cannon (1932). Reviews on the issue of individual response stereotypy state that the accepted indices of the degree of activation of the Autonomic nervous system do not correlate well with one another or with the psychological indicators of stress (Lacey, 1967; Martens, 1978; Sanders, 1983; Niess, 1988).

In the human performance and sport psychology literature similar problems also exist. Oxedine (1970) proposed that skills which require fine motor coordination seemed to be performed better at lower levels of activation than the skills requiring gross motor movements. Discrepencies still exist in performance studies where subjects maintained they were feeling calm but their physiological measures indicated otherwise (Karteolis, 1985).

Attempts to isolate the elusive variables led Fenz (1975) to record physiological and subjective responses in parachustists to sky diving. One variable which demonstrated a consistent influence on the degree of physiological and psychological activation was experience. Those jumpers who were inexperienced demonstrated a different response from those individuals who were experienced. Both groups displayed elevated levels of psychological activity, but at different times. It was also demonstrated that the manner in which the subjects perceived the situation influenced the physiological response. Skydivers who appraised the situation as a problem responded differently than those who thought the scenario was personally threatening.

Further efforts to identify reasons for the differences in psychobiological activation addressed how coping strategies may effect somatic activity. Obrist and his colleagues (1976) monitored changes in blood pressure in response to different coping methods. Active coping methods resulted in an increase in systolic blood pressure and passive coping resulted in diastolic pressure increases. The work of Fenz (1975) and Obrist (1976) reveal the importance of upper cortical activity in influencing responses to potentially stressful situations.

The idea that neocortical factors influence anxiety responses can be traced back to Freud (1932). Freud proposed that there had to be external dangers or fear, and, perception of the danger, present in order for an anxiety response to occur. The response was labelled *objective anxiety.* In addition to responses to external stimuli individuals could also create internal anxiety in the form of internal impulses which, unfortunately, were postulated by Freud as being only sexual in their origin. Anxiety with internal origins was referred to as *neurotic anxiety* and were the result of adversive conditioning. The main point was that the manifestation of both types of anxiety required some form of perception of the situation as being threatening.

Spielberger (1966) divided anxiety further, into Trait Anxiety (A-Trait) and State Anxiety (A-State). A-trait was defined as

> "... a motive or acquired behavioral disposition that predisposes an individual to perceive a wide range of objectively nondangerous circumstances as threatening, and to respond to these with A-state reactions disproportionate to the magnitude of the objective danger." (p. 17)

A-state or State anxieties

> "... are characterized by subjective, consciously perceived feelings of apprehension and tension accompanied by or associated with activation or arousal of the autonomic nervous system. the important addition to the anxiety concept is that the A-trait is an indicator of the individual differences in anxiety proneness to a given situation." (p. 17)

Anxiety , however is only one possible response which may be elicited by an individual. A common problem in stress research has been an inconsistency in differentiating between stress and anxiety. (Spielberger, 1966; Feuerstein, Labbe' & Kuczmierczyk, 1986). As demonstrated by Ekman, Levenson and Friesen (1983) different emotions have different physiological responses associated with them. A possible explanation for the inconsistencies in correlating stressors with a stress response could be that different emotions were exibited by the different subjects, altering the person's degree of sympathetic/parasympathetic tone. For example fear causes reddening and swelling of the mucus membranes and of the stomach; the same effect is demonstrated in response to cold, exhausting exercise and to adrenaline injections. Anger on the other hand , causes the membranes to become pale and shrunken (Wolff, 1950). Fear evokes an adrenergic effect and anger elicits a cholinergic one, similar to reactions to heat or injections melcholyl or insulin (Arnold, 1967). It is evident that even if there was only a single emotion-cognitive response to a situation , the physiological responses would still differ between individuals for the same stimulus.

The sequence of events which transpire between the stimulus appraisal and a person's action is much more complex than a linear stimulus-response paradigm would suggest. The act of appraising the stimulus involves a complex web of interactions between different parts of the brain. Past experiences, associated memories and emotions, the intensity of and meaningfulness of the affiliated thoughts and feelings contribute to determining how an individual chooses to cope with the situation. In order to gain the necessary insight to the richness of the experience and its impact on an individual the phenomenology of it must be addressed. As Arnold (1967) points out: "When we refuse to make this preliminary phenomenological analysis and depend exclusively on neurological research to provide clues we are bound to go astray" (p. 129).

The consideration of personality is important because it is a major component of the "person" variable in the equation of the person environment interaction. When adopting a transactional approach to explaining stress and stress responses both the physiological and psychological aspects of the individual have to be addressed. Evans (1986) suggested that the personality component of the person mosaic is more important than the environmental consideration. Theorists, in their attempt to explain human behavior, point out the critical role of stimlus characteristics. Fiske and Maddi (Maddi, 1968) use the adjectives meaningfulness, variation and intensity to elaborate on the description of the stimulus. Lazarus (1967) states that the important factors of stimulus configuration, or, characteristics are: 1) degree, 2) location, 3) viability of possible solutions and 4) social or situational constraints. Both approaches demonstrate the importance of personalizing the event. Fiske and Maddi incorporate the importance of emotion in developing the significance of "meaningfulness" as a dimension of stimulation which can be external, internal (physiolgical or biochemical) or cortical in nature. Basically, their position on what makes people tick is when a stimulus is encountered the "customary level" of activation for the individual changes to an "actual level" of activation . The amount of discrepency between the two depends on the magnitude of the three stimulus dimensions. The resulting behavior would be an attempt by the person to return the customary level, a level which is learned through day to day activities. The major implication for stress research is that if the customary level is subject to change, new levels can be acquired; levels that could be pathological and specific to the individual, but, based on the significance encountered stimuli have for the person. Meaning which is dependent upon emotional and psychological factors of the person.

It is evident that in order to begin to understand the development of idiosyncratic responses to stress, psychological and emotional variables have to be considered. Beyond the cerebral considerations, the question of the existence of physiological patterns of response has to be addressed at the systemic level.

Illnesses which have been linked to stress effect all systems within the body. Cardiovascular disorders, gastrointestinal problems and respiratory difficulties are a few examples of the large number of problems thought to be associated to stress (Feuerstein et al, 1986; Garssen, 1980).

One accepted theory regarding the link between stress and illness is the General Adaptation Syndrome (Selye, 1976). As suggested by the title the General Adaptation Syndrome, or, GAS there is a general response by the body to long term stress. It is a specific somatic response to a non-specific stimulus (Selye, 1976). If, in the long run stress results in the manifestation of the GAS, the issue of why some people develop cardiac problems and others gastrointestinal problems must be addressed. One facet of the dilemma is that the GAS is the result of an increase in activation of the sympathetic nervous system. This position is acceptible if stress elicits a response which is arousing in nature, such as in response to fear or anger. However, homeostatic adaptation is a result of modification to sympathetic and parasympathetic tone. Therefore, if a person responds to a situation with feelings and emotions associated with despair or hopelessness a change in autonomic tone will occur; there will be an increase in parasympathetic tone (Richter, 1957; Vingerhoets, 1983). Again, differences in physiological activity to a potentially threatening situation depends on perceptual content. Although considering which part of the autonomic nervous system is dominant may give some indication of which disorder may develop, it still does not explain why some people get a certain disorder and others don't even if they respond in a similar manner. According to Wilder (1957) there is one system within an individuals's body which is more susceptible to disease than others. There is a weak link. Research on hypertension (Falkner, Oneski, Angelakos, Fernandes & Langman, 1979) and hyperventilation syndrome (Garssen, 1980) indicates that there may be a genetic factor predisposing children who have a familial history of the disorder to develop it as they mature. The research is by no means conclusive, but, does indicate that in order to fully understand how an individual develops a chronic illness, a familial history should be considered.

To confound the issue of idiosyncratic responsivity to stress even further, the validity of laboratory situations has been questioned. Concern has been expressed about the impact of laboratory sessions compared to real life situations. Literature and reviews in stress and stress management indicates that there exists a need to conduct wholistic research in real life situatuions in order to gain a better understanding of how stress patterns develop and contribute to the development of specific disorders (Feuerstein et al, 1986).

B. Statement of the Problem

Search and Rescue technicians are an occupation within the military which require extensive and rigorous training in a number of different specialties ranging from advanced lifesaving techniques, parachuting, scuba diving and mountaineering, just to name a few. Unfortunately, even the exhaustive preparation during their training doesn't prepare them for all the problems they encounter on the job. The training phase provides an ideal setting in which to test individual responses to stress in a "real" situation. The central purpose of the study is to identify how SARTechs respond physiologically and psychologically to three different situations which are inherent to their work environment.

Sub-problems associated with identifying the idiosyncratic responses to stress involve identifying whether the responses which are elicited follow a pattern. In order to accomplish this continuous monitoring of the subject must occur.

Other sub problems are methodological and involve the utilization of instrumentation sensitive enough to record the physiological changes over a long period of time and unobtrusive enough so as not to be cumbersome and interfere with the subjects' activities.

As well, different forms of data have to be described and linked to one another in an attempt to gain a "complete" understanding of stress responses.

Also, the identification of respiratory patterns which suggest the possibility of pathology creates yet another subproblem.

C. Justification of the Study

With the genesis of the concept of idiosycratic response patterns new lines of research can be pursued in attempts to determine what factors may influence the development of these patterns. Intuitively, the same variables used in previous research dealing with elevated levels of activation would be used, and, some previous findings will be further substantiated and others refuted. However, the focus of the research will have to be on the individual (Ursin et al, 1978). The group design methodology has contributed significantly by helping identify possible mechanisms of action, but, in order to understand how a malady may develop as a result of stress, individual responses to novel situations have to be determined.

Studies have attempted to use multiparametric approaches in stressful situations, but, looking at a brief moment in the overall time frame of an individual's reaction to a stressor will tell us little about the reaction of the individual as a whole or how the response may develop. The pattern of how an individual responds may indicate that the highest level of activity may be at the time information on the situation is received, where as a different individual may respond more vigorously upon exposure to the situation. For example, one SARTech may demonstrate a higher level of psychobiological activation when he is informed that he is selected to perform a rescue. A different individual may not demonstrate any concern or experience any anxiety until he reaches the scene, and yet another individual may not react until the day after the rescue, when he has had time to contemplate his actions. If one were to base the predicted outcomes of various individuals' responses to a single stressoror situation there would be a number of possible reactions. It becomes quite evident that when one begins to consider other components with in the rubric of stress such as personality, coping strategies or possible genetic influences, the number of response possibilities in one subject is astounding.

If individual patterns can be identified perhaps future research can then determine what combinations of characteristics are maladaptive. If maladaptive patterns can be identified preventative measures can be implemented before the individual reaches a state of disease. There are also implications for performance enhancement. By being able to identify the onset of a pattern, the best mode of treatment can be chosen based on the individual's response and the time during which the pattern starts to manifest itself.

Chapter II

REVIEW OF LITERATURE

The nature of the theoretical and experimental approaches to stress have tended to migrate towards a transactional perspective, or, a person- environment interaction. At the same time there has been a focus directed towards considering the variables associated with the transactional approach and how their interaction may effect a stress response. By adopting a position that stress is a rubic or system, research can begin to elucidate the complexity of the person-environment interaction.

The focus of this study was to establish the relationship and the effects of perceptual influences on respiratory and heart rate responses individuals exhibited to situations that have demonstrated as being normatively stressful. Within the transactional paradigm the perceptual aspect of the study represents both environmental and personal variables indicating that people take an active role in determining the effect that the environment has on them. By adopting this perspective the individual differences exhibited in previous research would seem to be more readily explained. However, there is some indication that there exist physiological differences in reactivity between different subpopulations of individuals. Asthmatic individuals or individuals demonstrating characteristics of hyperventilation syndrome seem to demonstrate a hyper-responsivity of the respiratory system; hypertensive individuals reveal a hypersensitive cardiovascular response.

Although different pathological conditions demonstrate a hyperresponsivity of a given system there continues to exist voluminous amounts of data which show significant amounts of variability in responses within the pathological groups, indicating the importance of adopting a multifactoral approach to studying stress. Only by utilizing a paradigm that allows for the integration of a number of factors can individual reactions to stress be understood, and, perhaps predicted.

The review will demonstrate the need for adopting a transactional approach to analyzing stress. This will be accomplished by revealing how different influences effect the stress response. The possibility of genetic influences will be addressed by looking at how individuals with a predisposition to a given disorder respond to stress. To demonstrate the effects psychological factors have on influencing a stress response, coping and perceptual effects on psychobiological activity will be presented.

A. Genetic Influences on Responsivity

Cardiovascular Influences

One consideration when determining possible influences on individual responsivity, is the existence of an individual's genetic predisposition to respond in a given manner. According to Sternbach (1966) there exists an end organ or system that is more suseptible to disease than others within the body. The End Organ Theory assumes the existence of a genetic predisposition. If the theory is valid, those individuals who have a history of a given disorder should reveal a similar pattern to one another and the pattern should differ from that of individuals with a normal history. Research in the area of hypertension has supported this position. The ability of stress to elicit a characteristic cardiovascular response in hypertensive individuals and individuals with a history of hypertension has been demonstrated racially (Light et al, 1987), as existing across different stressors (Anderson et al, 1987; Goldstein, 1987; Allen, Sherwood & Obrist, 1987; von Eiff, 1985), as being stable over time (von Eiff, 1985; Cinciripini, 1986) and being influenced by caffeine (Goldstein, 1987; Greenberg & Shapiro, 1987).

Hypertensive individuals and those individuals with a history of hypertension tend to respond to stress more vigorously cardiovascularly than subjects with a normotensive history (Ginter, Hollandsworth & Intrieri, 1986; Manuck, Giordani, McQuaid & Garrity, 1981; Falkner, Oneski, Angelakos, Fernandes & Langham, 1979).

In an attempt to determine if similarities existed in cardiovascular responsivity between hypertensive adolescents, adolescents with a familial history of hypertension and normal adolescents, Falkner et al (1979) demonstrated that significant differences in heart rate, systolic blood pressure and diastolic blood pressure were evident between the groups under mental stress. Individuals within the hypertensive history group and labile group differed significantly on all parameters from the control group. Overall, the labile group demonstrated a higher degree of responsivity. Although the subjects in the group with a familial history of high blood pressure did not have hypertension, their stress response pattern as measured by heart rate, systolic blood pressure and diastolic blood pressure was very similar to that of the labile group. The authors suggested that "... the similarity of the stress response pattern is striking in face of strong genetic potential for essential hypertension" (Falkner et al, 1979; p 29).

Adolescents with a mean age of 14.8 who had a history of hypertension revealed exaggerated cardiovascular responses when compared to adolescents with normotensive parents (Anderson et al, 1987). The adolescents with a familial history of hypertension exhibited greater forearm blood flow and a decrease in forearm vascular resistance where adolescents from a normotensive history revealed increases in vascular resistence. Interestingly, both groups displayed significant increases in systolic blood pressure, diastolic blood pressure and heart rate in response to mental arithmetic but, there was no significant difference between the groups.

However, von Eiff et al (1985), discovered that in children of hypertensive parents, systolic blood pressure was significantly higher than in children with normotensive parents. The longitudinal study indicated that heart reactivity to mental stress was the most stable indicator of a stress response after a period of one year. In addition, children who had excessively high heart rates demonstrated increases in ambulatory systolic blood pressure by 7mm Hg, leading the authors to postulate that excessive heart rate reactivity may be an indication of a predisposition towards hypertension. The hyperreactivity of cardiovascular responses in children of hypertensive parents and grandparents was also reported by Hastrup et al (19[illegible]).

Research on adolescents and children reveal that characteristics of hypertensives reactivity can manifest itself early on in an individual's life. The pattern, however, is not limited to young children. In a study conducted on 69 undergraduate males, 20 of whom had a history of hypertension, Manuck et al (1981) determined that the subjects who had a history of hypertension exhibited significantly higher systolic blood pressure than subjects with a normotensive history. Contrary to other evidence (Falkner et al, 1979; Light et al, 1987) the other parameters of heart rate and diastolic blood pressure did not exhibit any significantly different degree of elevation between the two groups.

The potential to use systolic blood pressure to predict differences in cardiovascular responsivity was demonstrated by Light et al (1987). Men who had a moderate level of systolic blood pressure elevations had higher systolic blood pressure elevations than those who had a normal initial systolic elevation. In those same subjects systolic blood pressure was an indicator of higher systolic blood pressure, diastolic blood pressure and heart rate changes from baseline, indicating a hyperresponsivity of the system.

A study comparing borderline hypertensives to normotensives, borderline hypertensive subjects demonstrated a greater basal blood pressure than normotensives (Schulte et al, 1986). As well, during mental stress the borderline hypertensives exhibited larger increases in systolic blood pressure, diastolic blood pressure, cardiac output, stroke volume, heart rate and decreases in total peripheral resistance than normotensive participants, indicating a strong cardiac response in hypertensives during mental stress.

Individuals who have a history of hypertension or have hypertension also exhibit an exaggerated response to caffeine. In subjects with a history of hypertension caffeine ingestion resulted in increased systolic blood pressure during a resting period and mental arithmetic. The effects of the caffeine and arithmetic was additive (Greenberg & Shapiro, 1987). However, contradictory to Greenberg and Shapiro (1987) findings, Goldstein and Shapiro (1987) demonstrated that in subjects with hypertension, 200 mg of caffeine did not have an additive effect to mental arithmetic. The caffeine, compared to a placebo, increased blood pressure by 8/6 mmHg during rest but had no effect on heart rate or skin conductance. Mental arithmetic and caffeine resulted in an elevation of systolic blood pressure by 17/7 mmHg, but the effect was not significantly different than that of mental arithmetic and the placebo. The authors postulated that the inability of caffeine to elicit an increase in systolic blood pressure during mental stress was due to a ceiling effect. Since hypertensives may have already displayed a hyperactive response to the mental stress, the addition of caffeine would not contribute to increasing the level further, since the individuals were at the limit of their responsivity.

The preceding studies demonstrate that hypertensive individuals, borderline hypertensives and individuals with a history of hypertension display a cardiovascular hyperactivity to stress. The parameter that appears to be most sensitive to stress is systolic blood pressure. Although hypertensive individuals, and, those individuals prone to hypertension exhibit a hyperactive response in diastolic blood pressure, heart rate and other cardiovascular parameters, the predictive ability of these variables was not as substantial as the abilty of systolic blood pressure in predicting hypertension. This conclusion is supported by reviews in the area (Elliot, 1987; Light, 1987). Both authors agree that individuals with a history of hypertension and individuals with hypertension display a characteristic haemodynamic profile.

Although hypertensive and borderline hypertensive individuals reveal an elevated level of cardiovascular responsivity, the accepted reason for the activation was that the response was mediated by the smpathetic nervous system. (Steptoe & Vogele, 1986; Cinciripin, 1986; Julius & Johnson, 1985; McCubbin, Surwit & Williams, 1985; Schulte et al, 1986). Steptoe (1988) points out that during the execution of challenging tasks, concommitant excessive cardiovascular reactions are sympathetically mediated. It is further argued that although a pattern of hyperactivity has been identified in borderline hypertensives, it is difficult to identify in hypertensives (Julius & Johnson, 1985). Further evidence for the similarity between automomic activity and cardiovascular hyperactivity has been found in biochemical studies (Horikoshi et al, 1985; Eliasson, 1986; McCubbin, Surwitt & Williams, 1985).

Horikoshi et al (1985) demonstrated that norepinephrine and epinephrine concentrations changed significantly during the transition from the baseline measure, taken when the subjects were reclining, to a standing position in normotensive, borderline hypertensive and hypertensive individuals. Significant differences in baseline epinephrine and norepinephrine were only distinguishable between borderline hypertensives and normotensive participants. In response to mental stress only the plasma epinephrine changed significantly; plasma norepinephrine levels did not. According to the sympathetic activation position the borderline hypertensive should have revealed a higher degree of physiological activty compared to the hypertensive and normotensive groups. Interestingly, mean physiological measurements revealed that there was no differences between the three groups. However, in the group with a history of hypertension, 50% of the individuals were high responders whereas there were only 14% in the normotensive group and 12% in the borderline hypertensive group. As well, the high responders in the familial history group had significantly higher plasma epinephrine concentrations through out the experiment, and, had greater increases in epinephrine concentration than the low responders. This suggests that part of the reason for the exaggerated cardiovascular response in hypertensives is a result of adrenaline increasing the sympathetic effects of the stress. This is supported by Vincent et al (1986) who infused seventeen borderline hypertensive subjects with adrenaline. The results indicated that the increase in adrenaline concentration elevated blood pressure beyond that recorded during cold pressor and isometric exercise stresses.

Although the studies to this point indicate that there is a strong genetic predisposition for a developmental pattern of hypertension there is an indication that recurrent stressors may result in hypertrophy in the muscles of the vascular walls causing the walls to become more rigid eventually leading to chronic hypertension (Cinciripini, 1986). There are, however, descendants of normotensive parents who exhibit exaggerated responses and individuals of hypertensive parents who do not display hypertensive characteristics (Horikoshi et al, 1985). With the realization that there is a genetic component that contributes to the development of a hypertensive stress pattern, explainations for the inconsistencies in the research must be explored. The inconsistencies demonstrated are not limited to the cardiovascular system. Research on respiratory responses to stress has also been conflicting.

Respiratory Evidence

The genetic influences on stress responses has been researched to a lesser degree in the respiratory system than in the cardiovascular system. A majority of research involving stress has utilized breathing rate as the only indicator of respiratory responses (Everly & Rosenfeld, 1978). The evidence is contradictory as to the efficacy of breathing rate as being a good or bad index of respiratory reaction to stress. However, there is an indication that ventilation frequency alone may not be a good measure of elevated levels of activation (Stancak et al, 1987; Linden, 1987;

Winslow & Stevens, 1987; Cohen et al, 1986; Corson et al, 1980). There is research involving hyperventilation syndrome (Garssen, 1980; Heuy & West, 1980) with different psychiatric populations (Damas Mora, Grant, Kenyon, Patel & Jenner, 1976; Damas Mora, Souster & Jenner, 1982) and anxiety patients (Suess, Alexander, Smith, Sweeney & Marion, 1980; Gorman & Uy, 1987; Gaffney, Fenton, Lane & Lake, 1988; Gorman, Fryer, Goertz, Askanazi, Liebowitz, Fryer, Kinney & Klein, 1988) which indicate that respiratory parameters are sensitive enough to differentiate between individual breathing patterns. Parameters that have been utilized in stress/ respiratory studies include minute ventilation, tidal volume, alveolar pressures of oxygen and carbon dioxide and transcutaneous oxygen partial pressure (Myrtek & Spital, 1986; Weismann, Askanazi, Forse, Hyman, Milic-Emili & Kinney, 1986; Greenlee & Akita, 1985).

Empirical support for the role of inheritance in determining breathing patterns is scarce. Research on asthmatics indicate that there exists a strong genetic link associated with the probablity of getting asthma, but the onset and development of the problem involves a complex set of interactions (Crocco, 1986; Horwood, Fergusson & Shannon, 1985). Literature on the effects of stress on breathing patterns in different populations(Damas Mora, 1976; Damas Mora et al, 1982; Garssen, 1980; Gorman & Uy, 1987; Suess et al; 1980) suggests that the differences in response to stressors exhibited by the various groups may be physiologically dependent, but there are no indications, or, studies performed that would exclusively implicate heritability as a cause of *overresponsiveness* in the respiratory system. Therefore, research reviewed will focus on establishing the existence of differences in respiratory response patterns among different types of individuals.

Damas Mora et al (1976) demonstrated that psychiatric populations with the common symptom of depression breathed differently than a control sample. One hundred and thirteen patients with the characteristics of neurotics and non-retarded endogenous depressants demonstrated a higher breathing frequency and a lower end-tidal carbon dioxide level than normals. The retarded, endogenously depressed patients showed opposite but insignificant deviations from the control group; lower respiration rate and higher end-tidal carbon dioxide levels. In a later study (Damas Mora et al, 1982) it was revealed that depressed patients tended to overbreathe. Using a carbon dioxide rebreathing technique there appeared to be a high incidence of low carbon dioxide responses among endogenously depressed patients, indicating that individuals with various endogenous depression might have a less sensitive respiratory center than other populations.

A comparison between panic patients, patients with various other disorders and normals indicated that panic attack victims appear to have an exaggerated ventilatory response to carbon dioxide (Gorman et al, 1988). Other findings from the study revealed a tendency for panic patients to continue hyperventilate during the recovery phase, after exposure to 5% carbon dioxide and room air hyperventilation. During carbon dioxide inhalation panic patients had greater rates of increase per minute than nonpanickers and controls in alveolar oxygen pressure, tidal volume, respiratory frequency, minute ventilation, inspiratory flow, diastolic blood pressure, and plasma norepinephrine levels. However, the other indices of plasma epinephrine, cortisol lactate or systolic blood pressure did not demonstrate any differences between panic patients, non-panic patients or controls. The results of the experiment, in conjunction with the observation that panic patients had a lower partial pressure of arterial carbon dioxide, Pa CO_2, than the control groups, indicated that panic patients may be chronic hyperventilators (Gorman et al, 1988). The authors theorized that "... patients with panic disorder have CO_2 receptors, possibly in the brain stem, that are abnormally sensitive or at too low a set point at least part of the time" (Gorman et al, 1988; p 39).

In a study involved with the analysis of hemodynamic, ventilatory and biochemical responses to lactate infusions, it was revealed that panic patients and normals did not vary in the respiratory parameters measured (Gaffney et al, 1988). However the normal control subjects exhibited increases in ventilation volumes after twenty minutes of sodium lactate infusion where the patient group demonstrated higher levels after ten minutes. Lactate infusions are widely used as a nonspecific stressor and have been shown to elicit psychobiological activation, but it's mechanism of action is unknown (Liebowitz et al, 1985). Since lactate has been shown to be effective at inducing states of panic and panic patients are more suseptible to elevated levels of activation, there should have been differences in response to the infusion. The only significant difference occurred in the emotional self-rating measures of anxiety and sitting diastolic blood pressure. Although the level of the measures did not differ between groups, the rate of change did, indicating that ceilings may be reached sooner in some individuals than others. A common respiratory response in panic attacks is hyperventilation, which was exhibited by only two patients.

Hyperventilation

Hyperventilation is defined as breathing that is metabolically excessive (Bass & Gardner, 1985). The excessive ventilation results in a decrease in alveolar and arterial CO_2 levels. During a normal state of activation decreases in $PaCO_2$ levels would result in decreases in respiratory frequencies. However, in individuals demonstrating symptoms of hyperventilation syndrome the decreases in $PaCO_2$ appear to be associated with increasing anxiety which leads to further hyperventilation.

Research in hyperventilation syndrome has indicated that this problem may have been learned, and, is a difficult pattern to break. "Once established, imperceptible overbreathing may allow for its persistence or recurrent episodes of symptoms without apparent provocation. The symptoms of hyperventilation may be sufficient stress to maintain its persistence in a vicious cycle" (Magarian, 1982; p 233).

Experiments in healthy subjects and in non-HVS (hyperventilation syndrome) patients show that a mild degree of hyperventilation is part of the stress response pattern (Garssen, 1980), suggesting that hyperventilation syndrome is part of the general activation response system. Garssen (1980) further suggests that there exists "... a specific overresponsivity of the respiratory system in hyperventilation syndrome patients ..." (p 223) which is consistent with the concept of individual responsivity. Support for this position is provided by Suess et al (1980).

The study revealed that individual respiratory responses to stress varies (Suess et al, 1980). As well, respiratory frequency did not correlate well with end-CO_2. Approximately 26% of the decrease in end-tidal CO_2 was accounted for by increases in respiratory rates. However, significant decreases in end-tidal CO_2 correlated well with increases in heart rate and subjective measures of anxiety. Temporally, there were differences in respiratory response patterns between individuals. Measurements were taken at different times during the course of the study. There was a ten minute baseline established, followed by a two minute time frame when the subjects' ongoing participation was requested. Following the request, measurements were taken for two more minutes during which time the individual was requested to think about the offer and arrive at a decision. A Pre-task period lasting two minutes was used to monitor the subjects' anticipatory responses, and, was followed by a five minute task phase.

Most of the subjects demonstrated a decrease in their end-tidal CO_2 during the Pre-task or Task phase of the experiment. "Generally there was a significant decrease in end-tidal CO_2 for subsequent phases except for changes between the Request and Task phases" (Suess et al, 1980; p 538). The most significant difference in response patterns existed between the decision to perform the task and the Pre-task phase. The large differences between the two phases represents the anticipatory stage of the experiment, which has been suggested as an important phase in the development of a stress response (Linden & McEachern, 1985; Aurthur, 1988). Since averages of measurements were computed and utilized in the data analysis for each phase, it would be difficult to determine where the increases occurred within the time frame; at the beginning of the recording session, in the middle, or at the end of the session.

The weak correlation between $PaCO_2$ and the respiration rate has also been demonstrated in normal individuals encountering an examination (Garssen, 1980). Fourteen subjects were monitored during four different sessions. Sessions 1,2 and 4 were control sessions, approximately one hour long, and, session 3 was the examination session. The author reported that $PaCO_2$correlated well with heart rate and subjective anxiety ratings, a finding which was also supoorted by Suess et al (1980). Although a correlation between respiration rate and $PaCO_2$ was not evident, both studies revealed an increase in respiration rate with Suess et al(1980) reporting large individual differences in the fluctuations.

B. Effects of Coping on Psychobiological Activation

The methods by which people deal or cope with problems has been shown to influence the manner in which physiological parameters respond to stress. Support for the observation has been derived from two types of research, research focusing on the effects of treatments for stress and anxiety disorders on physiological responses, and, from psychophysiological research aimed at identifying individual coping styles and the ensuing psychobiological activity.

Group studies designed to test the effectiveness of various stress interventions techniques have demonstrated that when compared to control groups, the treatments are effective in reducing stress and/ or anxiety (Miller & Berman, 1983; Barrios & Shigetomi, 1979). However, the evidence is contradictory when comparative studies on the efficacy of different techniques have been conducted. No single intervention has been proven to be superior over another method (Barrios & Shigetomi, 1979; Durham & Turvey, 1987). The inability of any one method to be successful in promoting a change in some individuals and not in others presents an interesting problem to practitioners. If a general response pattern existed then for any given stressor any intervention should work on all people; but they don't (Cooley & Spiegler, 1980). Even when treatments were effective, the degree of effectiveness was variable (Miller & Berman, 1983). The most frequently stated reason for the lack of congruency amongst the findings is individual differences. Many authors maintain that in order for a treatment to be effective it has to be specific for the individuals needs (Durham & Turvey, 1987; Cappe & Alder,1986; Lindsay, Gamsu, McLaughin, Hood & Espie 1987; Lineham, Goldfried & Goldfried, 1979). For example, individuals who suffer from tension headaches may respond better to EMG biofeedback, while migraine sufferers exhibit greater improvements in response to temperature oriented interventions.

The effect of different coping strategies on physiological activity has been demonstrated to be related to the degree of experience an individual has in a given situation (Fenz, 1975), the type of coping strategy used (Obrist, 1976; Passchier et al, 1988; Steptoe & Vogele, 1986; Ursin, 1978; Wolff et al, 1964; Wolff, Hofer and Mason, 1964; Ellertsen, Johnsen and Ursin, 1978; Light & Obrist, 1980, 1983) and the emotional and cognitive state of the individual (Sebj & Biro, 1978).

People who are given the chance to express their anger in response to a confrontation have been shown to have a different physiologcial response than those individuals who repress their anger (Hokanson & Edelman, 1966). Subjects who were monitored for systolic blood pressure responses during provocation and recovery times demonstrated differences in the rate at which they returned to baseline levels following a situation in which they were supposedly angered (Hokanson & Edelman, 1966). The return to baseline was more rapid when the individuals were given the opportunity to respond as opposed to not responding. There were no differences in recovery times in response to the three coping alternatives. As well, females didn't achieve the same level of physiological relief as males, especially after the expression of counter-aggression. There exist, however, methodological concerns with the study that make the results somewhat questionable. Specifically, the subjects were never asked if they were angry.

A later study elaborated on the design of the Hokanson & Edelman (1966) study and improved on their earlier findings. Frodi (1978) delved more into the phenomenology of anger and revealed that angered men and angered women who were provoked responded in a similar physiological fashion. There were signifcant increases in systolic and diastolic blood pressure, heart rate and electrodermal responses. Men, however, tended to dwell on thoughts of anger, where women tended to be preoccupy themselves with thoughts that were non-aggressive. Similar results were found by Matthews, Manuck & Saab (1986) in adolescents during public speaking. High trait anger children tended to have higher systolic and diastolic blood pressures than low trait angry children. Although angry subjects exhibited higher diastolic pressure in general, when presented with the stress of of public speaking, non hostile subjects showed higher diastolic blood pressure, implicating the importance of coping strategies in influencing blood pressure responses.

Anger and aggression are emotions which accompany a number of coping behaviors and occurs when individual are provoked. The above experiments imposed the anger situation upon the subjects, but when individuals were given the choice to escape a given situation, changes in their physiological activity occur.

A study that utilized a multivariate approach to determine physiological patterns while an individual was in an escape or non-escape situation indicated that some physiological parameters differentiated between the two alternatives (Sandman, 1975). Significant changes we were found to occur in tonic galvanic skin potential, the number of nonspecific galvanic skin responses and heart rate, when the individual made the transition from a non escape to an escape contingency. Also when individuals were given the option to escape after initially not being able to do so, there were decreases in physiological activity.

Field Independent subjects, individuals who would be less likely to employ an escape mechanism, differ physiologically from Field Dependent subjects in the manner in which they respond to stress (Sandman, 1975).

> "Field Independent subjects demonstrated drastically different response profiles during escape and non-escape conditions especially for heart rate and non-specific galvanic skin responses. The Field Independent subjects also had a higher degree of correspondence between physiological variables and escape behaviors than Field Dependent subjects" (Sandman, 1975, p. 214).

The author suggested that the field independent and dependent individuals differ in the way they process physiological cues in order to determine perceptual and affective states. Field Independent people utilized the cues more readily, providing a feedbackloop which contributed to the exacerbation of the response. Although attention given to physiological activity may heighten the level of arousal, Obrist and his collegues (see Obrist, 1976) suggest that it is the manner in which an individual copes that dictates the physiological response.

A series of studies conducted by Obrist and his collegues (see Obrist, 1976) identified the differentiating effects of active and passive coping on the cardiovascular system.

> "With passive coping such as adversive conditioning, the heart is under more vagal control which is directionally linked with somatic activity, while blood pressure is more dominated by vascular processes. With active coping such as shock avoidance, the heart is under greater sympathetic control which is directionally independent of concomitant activity, while cardiac influences on blood pressure become more dominant" (Obrist, 1976; p 95).

Obrist further indicated the amplitude and direction of changes in heart rate were also influenced by how the organism decides to cope somatically, and, that heart rate and somatic processes are centrally integrated.

Lovallo, Wilson, Pincomb, Edwards, Tompkins and Brackett (1985) elaborated on Obrist's (1976) findings. By using a multiparametric approach it was demonstrated that both active and passive coping resulted in significant increases in the concentration of free fatty acids, cortisol and norepinephrine. Although both types of strategies result in significant changes, there was no difference in responses between the two strategies. Physiologically, the passive exposure condition resulted in increases in heart rate, pre-ejection period, peripheral resistence, cardiac index, contractility index and in changes of Q-wave to peak measures. During the transition from a passive coping approach to an active one, there were increases in muscle tension, heart rate, systolic blood pressure, cardiac index, contractility index and a shortened Q-S interval. Peripheral resistence changes were the same for active and passive coping, indicating that the muscular tension and cardiovascular adjustments were under central nervous system control (Lovallo et al, 1985). The results of the active situation were attributed to the control efforts of the individuals as indicated by muscle tension and task performance. During the active coping situation the subjects reported they felt: "greater control, sense of effort, tenseness, concentration, interested and were more stimulated" (Lovallo et al, 1985; p 286).

In an attempt to identify behavioral modifiers of physiological reactivity to active and passive coping Lovallo, Pincomb and Wilson (1986) found heart rate reactivity (HRR) to be a better indicator of elevated physiological activity than Type A behavior. HRR remained a stable indicator even after 12 months. There appeared to be an individual response pattern for HRR as well as a greater tendency for HRR to respond more to active avoidence. High HRR responders showed greater cardiovascular adjustments to active avoidence than low HRR responders. Neuroendocrine and plasma lipid measures also indicated response difference existed between high and low HRR in active and passive coping situations. Cortisol concentrations did not differ between the groups during the passive situation but did during the active situation. However, high HRR responders demonstrated higher overall norepinephrine concentrations. There were no significant changes between the groups in free fatty acids and epinephrine.

Electrocardiogram recordings and catecholamine concentrations also indicate differences in activation occur in response to the type of coping strategy employed (Hijzen, Van der Guoten & Bouts, 1984). Interestingly the difference was found to be independent of the degree of stress, which was determined by ergonomic exercise. The T-wave area was significantly less during active coping than passive coping. The T-wave flattening was indicative of a higher degree of sympathetic activation, which was not influenced by the degree of physical stress. Together high stress and active coping resulted in significant changes in plasma and urinary adrenaline measures and in urinary noradrenaline measures. Light and Obrist (1980) suggested that during active coping the peripheral effects depend on a continuous effort to cope which result in increases in noradrenaline concentrations.

The research by Lovallo et al (1985, 1986) and Obrist (1976) has contributed significantly to the understanding of how the active and passive approaches to coping influence cardiovascular and biochemical responses to stressful situations. The approach of limiting coping strategies to either active or passive neglects to address the finer question of the role of cognitions and emotions in coping responses. Given that people can cope either actively or passively, there are different ways of coping actively or passively. Based on Obrist (1976) passive coping techniques such as distraction or repression, should have similar response characteristics. Research on repression and physiological activity indicate individuals who disclose or supress emotions exhibit higher blood pressure readings (Cumes, 1983). Work done comparing hypertensive subjects with non-hypertensive subjects showed that hypertensive subjects were less inclined to report feelings of stress or changes in stress associated with a variety of different situations (Handkins & Munz, 1978). Another disorder associated with blood pressure is migraine headaches. Migraine sufferers revealed more self-aggression and expressed more emotions than controls (Passchier et al, 1988). The results imply that migraine subjects have an abnormal tendency towards vasoconstriction , especially the temporal artery in response to stress, and the exaggerated response is mitigated by the suppression of emotions (Passchier et al, 1988).

A multiparametric approach comparing repressors to high-anxious and low-anxious subjects indicated differences in self-report, behavioral and physiological measures (Weinberger, Schwartz & Davidson, 1979). Repressor responses to questions were slower and evasive in order to minimize their sense of threat; the relative ineffectivenss of their coping efforts was evidenced by increased heart rate, sweat gland activity, frontalis muscle tension and verbal interference. Although the repressors reported having less anxiety than the low anxious group, it was not paralleled physiologically. Taking repression into account in future studies may elucidate the relationship between subjective reports of anxiety and physiological measures.

Another aspect of coping involves the degree of vigilance exhibited by an individual towards a stressor. Vigilant individuals demonstrate consistently higher physiological and subjective responses to stress than individuals who distract themselves (Miller, 1979). Vigilant monitors also dwell longer on shock related thoughts. The author postulated that the monitors may be more impulsive or "sensation-seeking" than the distractors. Psychic load has also been shown to influence the depth of breathing, 0_2 uptake and respiration frequency (Sebj & Biro, 1978).

The impact of higher cortical functions on pulmonary activity can be demonstrated by the effect that consciously modified breathing has on various respiratory and physiological parameters. When individuals engage in behavioral techniques such as paced ventilation, there is a reduction in the level of psychobiological exhibited in response to stressors (Harris, Katkin, Lick & Habberfield, 1976). However, there is evidence to the contrary (Holmes, McCaul & Solomon, 1978). One reason for the conflict in findings was due to methodological differences between the two studies. Harris et al (1976) used paced breathing that was below normal and Holmes, McCaul and Solomon (1978) employed a ventilation frequency that was maintained at a normal rate. A study by McCaul, Solomon and Holmes (1979) utilized 110 male college students in order to determine the effects different rates of paced breathing had on psychophysiological levels of activation as indicated by galvanic skin response, heart rate and subjective reports. The subjects were randomly divided into groups that were given the same breathing instructions and different information pertaining to the severity of the shock. The evidence demonstrated that paced breathing below the normal level was effective in reducing all psychobiological levels of activation, in all conditions. However, when the respiration was maintained at a normal level, no beneficial effects were evident. Although the results of the experiment indicate the virtues of paced respiration and suggest that the individual response patterns may be physiologically dependent, another intriguing observation was made. Those subjects who were threatened displayed a higher level of physiological activity than the non-threatened group, even during slow breathing.

C. Perception

Perception is a broad concept that can be influenced by a number of factors. In the context of this presentation perception will involve the way that people interpret the situations they encounter. One individual may find a situation overwhelming, and, a different individual may consider the same situation as boring. Perception is a process that can be influenced by previous learning (Bem, 1972), stimulus strength, environment and temporal occurence (primacy effect) (Asch, 1946; Luchins, 1957).

Perception plays a critical role in some theories of stress (Cox, 1978). The role of perception in these theories involves the integration of previous knowledge with the knowledge gathered by the individual in a given situation. The information that is perceived within a given situation is then compared to existing schemata(Wertz, 1987).

The perceptual process involves the gathering and synthesizing of information based on preexisting schemata. The schema direct movements, accepts information and is modified in accordance with the new information (Wertz, 1987). It follows that all information associated with a given schemata would be involved in determining what is occuring within a given situation. Therefore, if an individual initially percieved a situation as threatening, corresponding physiological responses would become part of the information associated with the schema (Schacter and Singer, 1962).

Individuals tend to recall information that is perceived as fitting a schema, reinforcing the schema as time passes (Higgins and McCann, 1984). In terms of stress and anxiety, if certain physiological parameters are part of an existing schema, stimuli that evoke the emergence of the schema would elicit levels of psychobiological activity that correspond to the schema. A fundamental principle of cognitive interventions within psychology involve having individuals identify cognitions, emotions and feelings associated with existing schemata (Rogers, 1951; Meichenbaum, 1975; Ellis, 1977). Research on the efficacy of treatments for specific problems reveals that the more individualized the treatment the better the effect (Deffenbacher, 1985; Kelly & Stone, 1987).

It is well known that the upper cortical areas of the brain in man is where thought processes occur (Kandel and Schwarz, 1986). Gray (1987) presents biological evidence that links the prefrontal cortex, via the cingulate cortex, to the septo-hippocampal system which has the function of comparing actual stimuli with expected stimuli. He further states that

> "... this descending pathway is likely to be of particular importance in handling the kind of threat which depends for its formulation upon the semantic capacities of a language system" (p 338).

The existence of Purkinje cells and other types of neurons that have synapses in various regions of the brain allow for the integration of information from these different regions (Kandel and Schwarz, 1987). Therefore, the existence of this type of neurological communication allows for the retrival of schema components created in higher brain centers to converge upon the septal-hippocampal region. Support for the existence of this type of arrangement can be extrapolated from cognitive psychological research looking at the effects of various interventions on stress. Upon the completion of treatment programs many individuals state that their perceptions of the stressful situations had altered (Ordman and Kirschenbaum, 1985). However, another aspect of a stress response involves physiological activation. The activation level of various parameters used to measure a stress response also decrease in response to treatment (Friedman and Taub, 1984) further substaniating that the link between the septo-hippocampal region and the areas of the brain that monitor and control physiological activity must exist.

An example of the effects of perceptual differences on physiological activity can be gleaned from studies analyzing the effects of misattribution on physiological arousal. Slivken and Buss (1984) and Olson (1988) manipulated test situations in which subjects were told that certain stimuli would result in different effects.

Slivken and Buss (1984) compared the effect of misattribution on nervous behavior and speech anxiety in 30 high speech anxious and 30 low speech speech anxious subjects. Fifteen individuals from each type of speech anxious group were presented with the misattribution that bodily preparedness influenced the success of a speech. The results indicated that the misattribution presented did not influence the speech performance of either the high or low group.

In contrast, when individuals were told that certain extraneous stimuli were responsible for the way they felt, there was a decrease in the emotionality exhibited (Olson, 1988). By using the suggestion that subliminal music was responsible for the feelings that were felt during a speech, individuals who were allegedly exposed to the music showed fewer dysfluencies during their speech. However, when accurate information was given for the reason of their anxiety, the ameliorative effect was not observed. The author attributed the discrepancy in performance and emotionality between the two groups to be due to the subjects attributing their anxiety on factors (ie. the music) other than themselves, ultimately modifying the individual's perception of the cause of their anxiety.

By actively perceiving the environment in which we are engaged, we expend mental energy, become more attentive, involved and concentrate more on stimuli contained within our phenomenological field (Hensel, 1979). Instead of just "hearing" we are "listening". "Thus the act of perception turns out to be an act which can be characterized as intentional" (Hensel, 1979; p 98).

In regard to stress, if we perceive something as stressful it is because previous learning and the nature of the stimuli dictate how much energy we expend in an attempt to place the stimuli within our belief system and deal with the problem. Different individuals will perform this to varying degrees based on the intensity, meaningfulness and the novelty of the stimuli (Maddi, 1968).

D. Summary

Since the conception of individual response stereotypy of responses (Lacey, 1967) a great deal of research has been done in an attempt to determine what may account for the differences in the manner people respond to stress. Cardiovascular studies have demonstrated that heredity may play a role in the development of response patterns but, the evidence is weak at best. There doesn't seem to be a strictly physiological model that could explain the differences in response. Research incorporating hypertensive individuals demonstrates that hypertension does develop over time and is associated with cardiovascular overresponsivity. However it is difficult to elucidate the relationship between the physiological and environmental influences. Although some children of hypertensive parents exhibit elevated heart rate, systolic and diastolic blood pressure, cardiac output and stroke volume, the changes were not always evident in subjects of a hypertensive history.

The common explanation for the cardiac overresponsivity has been excessive sympathetic activation. However, studies analyzing catecholamine concentrations and their relationship to hypertension indicate that no statistical relationship exists between the variables. Therefore if hypertension is a disorder that develops overtime, there must be some other variable that can influence sympathetic activation. Psychosocial stressors have been implicated as a major factor in the development of hypertension (Everly & Rosenfeld, 1981). Differences in the way in which individuals perceive the stressors would account for the development of hypertension in normotensive individuals, and, the absence of the condition in people with a predisposition to hypertension.

Research on respiratory responses to stress suggests that genetic influences may predispose a person to respond in a given manner, but , stress also contributes substantially to the exaccerbation of the response. Differences in the manner in which different psychiatric populations breathe in response to stress suggests that different breathing patterns exist. The major physiological position involving differences in breathing is that anomilies exist within the respiratory centers of the pons and the medulla oblongata. Very little consideration is given to the effects of upper cortical areas.

The research indicates that the ability a specific situation has for elicting an idiosyncratic response in humans is heavily dependent on the perception the individual has of the circumstances present at the time and the skills the individual enters with. Because humans play an active role in perceiving their environment, the initial consideration in determining how an individual may respond to it requires insight into his/ her phenomenological world. Modifications to the existing homeostatic condition are effected by a person's perception. The dilemma is in identifying how perception alters the somatic steady state, is deciding where to begin. Perception is influenced by personality. Personality is inturn moulded by experiences, in the form of past successes and perceived failures. Those experiences dictate the coping strategy employed by an individual to deal with the demands required to deal with the change in the environment. Therefore inorder to ascertain how a person may respond to an alteration in the environment, an awareness of the presonality and coping strategies of the individual must exist.

The concepts of personality and coping also require further refinement, and the realization that both are interdependent. Self-esteem, self-efficacy and other components have to be considered. An understanding of the role of different personality variables may lead to an explaination of why a certain coping strategy was employed by a particular individual, implying that the response an individual does choose is exactly that, a choice! An active role is taken. Even if the response is passive, or, no overt behavior is demonstra d the individual chooses to respond; the reason for the response lies with in the realm of past experiences.

Thus the first variable to consider in identifying a given response pattern is the interpretation of the stimuli. Next, is the selection of the coping strategy. The choice of coping style may provide feedback which could alter the interpretation of the stimuli. However, the selection of the coping style results in changes in the degree of sympathetic and parasympathetic tone. Modifications in the degree of autonomic tone leads to a change in the level of activation in the body's sysytems. The information provided in the preceding review indicates certain individuals may demonstrate systemic hypersensitivity to alterations in homeostasis which is in part genetically predetermined.

In making this statement, the assumption is that the human body is an ever changing environment, and, the changes to the existing state occur in response to changes in the external environment and the internal environment.

Since personality is composed of traits which Speilberger (1966) defines as enduring characteristics, and, the coping styles employed by an individual contribute to the personality, the physiological response which follows an encounter will also be enduring. It will be repeated. The response transends the simple stimulus-response paradigm because stimuli which evoke the response can be generated neocortically, and, the process from perception of the stimulus to an overt behavior could involve so many possible pathways and incorporate so many or diverse emotional and cognitive variables that the response demonstrated to that particular stimulus might never again be repeated. A simple example would be the electrical stimulation of muscle groups in response to thoughts of movement, or, successful application of relaxation techniques in a given individual. In this situation extraneous emotions and cognitions are eliminated reducing and minimizing excessive physiological activation. In a situation where depression is a response to stress there may be a need to adopt cognitions, emotions and behaviors which elevates the degree of sympathetic tone. The confusing array of research findings attempting to elucidate the physiological response to change can be explained by considering the body's attempt at establishing a new homeostatic condition. A task which is perpetual because different hormones have different half lives (Guyton, 1986) and different cells have different metabolic functions and respond differently to chemical changes within the body; providing information to the Central Nervous System and the Autonomic Nervous System about the condition of the internal mileau. Information which may or may not provide new information to the individual's perceptual mechanisms. Thus beginning a new cycle. If the information reinforces the initial response similar systems will be activated creating further alterations in sympathetic and parasympathetic tone of various tissues within the body. If characteristics exist in the environment such that the individual is continually exposed or ultimately overwhelmed, pathological conditions may be manifest.

Chapter III

METHODOLOGY

The nature of stress and the factors that influence it has made the use of a group design less applicable in research directed at clarifying the idiosyncratic processes associated with responses to stimuli. If stress and it's effects are to be examined further, within a person and environment interaction paradigm, a number of factors must be considered; many of which differ for each individual.

A major variable to consider is the individual's appraisal of the situation (Eichler, Silverman & Pratt, 1986). The appraisal of the situation is in turn effected by personality characteristics such as an individual's inclination towards sensation seeking (Dohrenwend, 1986) and previous experiences in similar situations (Fenz, 1975).

Although the objective nature of the environment can be maintained during research, there exist different aspects of the environment to which different individuals will attend. A transactional approach to studying stress makes it difficult to objectify those differences.

> " Those who press the demand for purely objective measures of stress present a classic catch-22 situation to those of us who say that no environmental event can be identified fruitfully as a stressor independently of its appraised significance to the person, even when such an event is normatively stressful" (Lazarus & Folkman, 1984; p 49).

Therefore in order to satisfy the conditions created by a transactional analysis of stress responses, a case study approach would provide the insight required. The nature of a case study does present certain limitations, but, it also provides information that has traditionally been obscured by group design approaches, most notably, individual response differences to stressors.

In the current study which used a case study approach, three subjects were exposed to three different kinds of normatively stressful situations during which their physiological responses were monitored. In conjunction with the physiological data, sensation seeking and phenomenological information was also accumulated.

A. Operational Definitions

Activation - The degree of physiological activity demonstrated by an individual at any given time as indicated by changes in tidal volume, respiratory frequency, minute ventilation, inspiratory volume, expiratory volume, paradoxical breathing and heart rate.

Baseline - The 20 minute period of data collection during which the subject was sitting quietly in an atmosphere that was quiet and relaxing for the individual. The subjects were asked to focus on deep diaphragmatic breathing.

Coping - The cognitive and behavioral strategies that an individual employed in an attempt to deal with the situation, as indicated by comments made during an interview.

Mental stressor - A situation which has the potential for making an individual question his ability to deal effectively with the perceived demands of the situation as indicated by verbal responses given by the subject during an interview.

Perception - The process an individual engages in when determining the meaning and degree of severity of a stimulus as indicated by comments made during a structured interview.

Sensation Seeking - The degree to which an individual is prone to engage in high risk activities as indicated by Zuckerman's Sensation Seeking Scale.

B. Experimental Design

The format of the experiment involved a time-series design during which physiological activity was recorded and averaged over various time periods. However, in order to increase the generalizabilty of the study a modified unit repetitive time series design was used (Kratochwill, 1978). The design involved having an intervention used across a number of individuals as opposed to only one or two (Glass, Wilson & Gottman, 1975). The use of a case study approach provides the researcher with the opportunity to monitor trends and changes within an individual over a period of time.

> "Interventions ... do not have merely 'an effect' but 'an effect pattern' across time. The value of the intervention is properly judged not by whether the effect is observable at the fall harvest, but by whether the effect occurs immediately or is delayed, whether it increases or decays, whether it is only temporarily or constantly superior to the effects of alternate interventions" (Glass, Wilson & Gottman, 1975; p 5).

Although the intervention in the study was not a treatment intervention, the idea of determining the pattern of a reaction to changes in the environment is very applicable to stress research. & Gottman, 1975). The general design for each individual followed the format: O-I_1-O-I_2-O-I_3-O-baseline. Since people have different levels of activation through out the day a baseline was established in order to have some control from which to measure changes in the response to the stressors.

The physiological recording equipment was attached to each subject between 0730 hrs and 0830 hrs during which time the instruments were calibrated according to the Vitalog procedures (Vitalog, 1983). There was continuous monitoring from the completion of the calibration until the end of the day. This was done in order to record changes that indicated fluctuations in physiological activity.

Each subject was exposed to three situations. The situations to which they were exposed included a medical simulation, a written examination on trauma and an oral examination. In the medical simulations one subject was a group leader and the other two subjects were given the role of technician. The simulation teams were composed of two members. One team had one subject being the group leader and another subject as the "buddy". The third subject was a "buddy" in the second team. The subjects were not informed of their order for the oral board examination until ten minutes prior to it's onset. Upon completion of the exam the subjects were individually interviewed by the experimenter.

Following the completion of each of the interventions the recording apparatus remained in place in order to record the recovery process. After the last intervention each subject was questioned at length about their experiences in the situations. Insight into the individual's life was gathered during the interview as well.

Subjects

The subjects were three male Search and Rescue Technician trainees who were approximately half way through their six month training program. The study was integrated into the existing program and the situations they were exposed to duplicated some of the demands they eventually would be exposed to in their occupation. The subjects were given the option to participate in the study. They were also informed that the results of the study would not incriminate them in any manner.

Manipulations

Since Obrist (1976)demonstrated that somatic coping resulted in different blood pressure and cardiac responses than passive coping three different types of situations were used in the study; a medical simulation, a written exam and an oral exam.

Medical Simulation

(Plate la, b, c)

The medical simulation was a scenerio which is used to test the participants ability to apply his knowledge. The extent and severity of the injuries of the "victim" were unknown to the SARTech until he arrived at the scene. Failure to pass the simulation portion of the course would have resulted in the failure of one subject to pass the entire course. The other two were not in the same set of circumstances. They had already passed.

Written Examination

The written examination consisted of a 50 Question multiple choice test for which the subjects were given one hour to complete. The material in the exam was based on information covered in the trauma portion of the course.

Plate 1a

Plate 1b

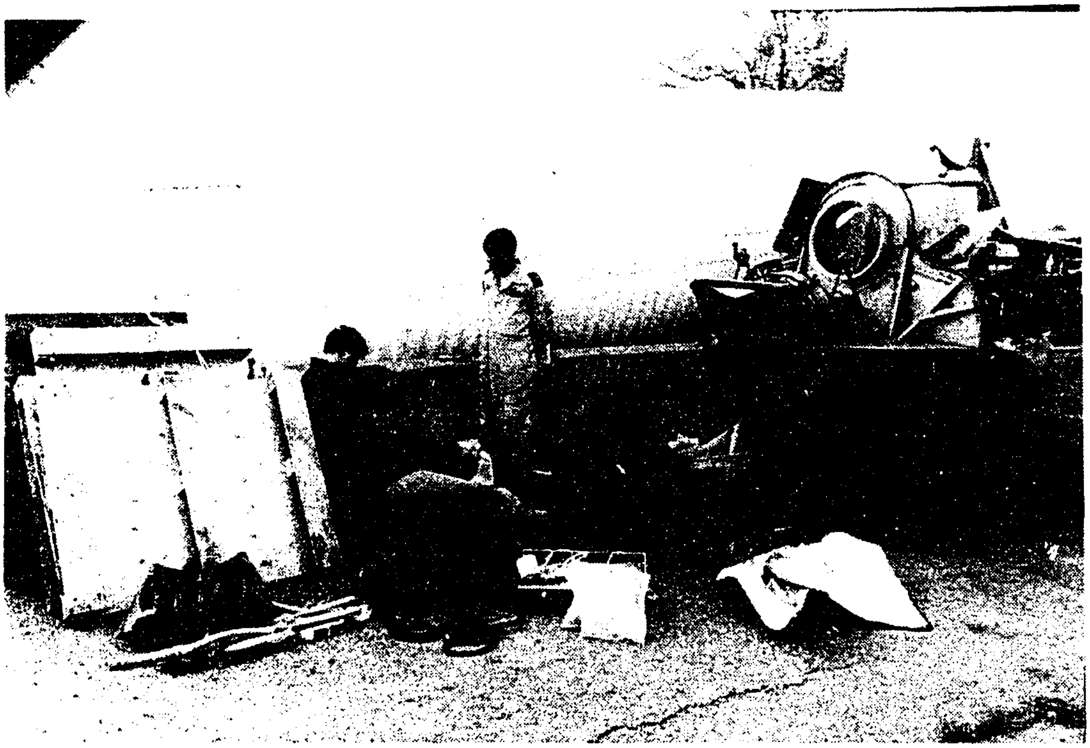


Plate 1c

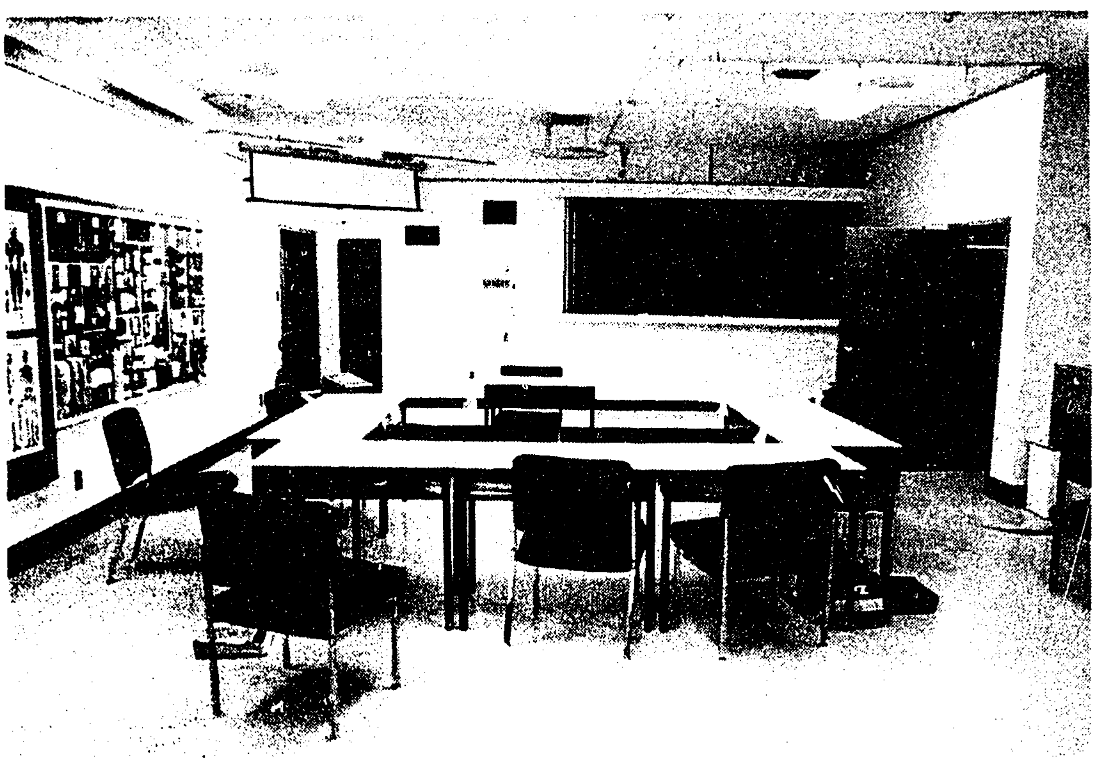


Plate 2

Oral Examination

(Plate 2)

During the oral examination the subjects were individually seated in a situation where they had to answer questions pertaining to how they would treat victims in a given situation and why. The subject took up a position in front of a panel of questioners who consisted of a military doctor and two course conductors.

C. Physiological Variables

Measurements of the following respiratory parameters and heart rate were monitored continuously for each subject: 1. respiration rate, 2. tidal volume, 3. inspiratory volume, 4. expiratory volume, 5. minute ventilation, 6. paradoxical breathing, 7. heart rate.

Instrumentation

All respiratory measurements were recorded and processed by a Vitalog PMS-8 portable microcomputer. Battery checks and calibration of the equipment was performed by an experienced technician in the classroom in which the medical phase of the course had been conducted. An IBM computer was used for all the calibrations. All the connections and electrode leads were examined for faulty parts.

Pre-calibrated chest and abdominal sensor bands were strapped to the subjects (Plate 3). The electrodes, leads and the strain gaugeswere held in place by a body net (Plate 4).

Heart rate was also monitored by the Vitalog PMS-8. Adhesive electrodes were attached to three areas of the chest (Plate 3):

1. fifth intercostal space 10 cm lateral of the sternal midline
2. approximately 5 cm below the halfway point of the left clavicle
3. approximately 7 cm inferior and lateral to the left nipple.

Before the electrodes were placed on the skin, the surface of the skin was abrazed and then swabbed with rubbing alcohol. A 3-M brand of pre-gelled electrodes were then applied to the cleaned areas.

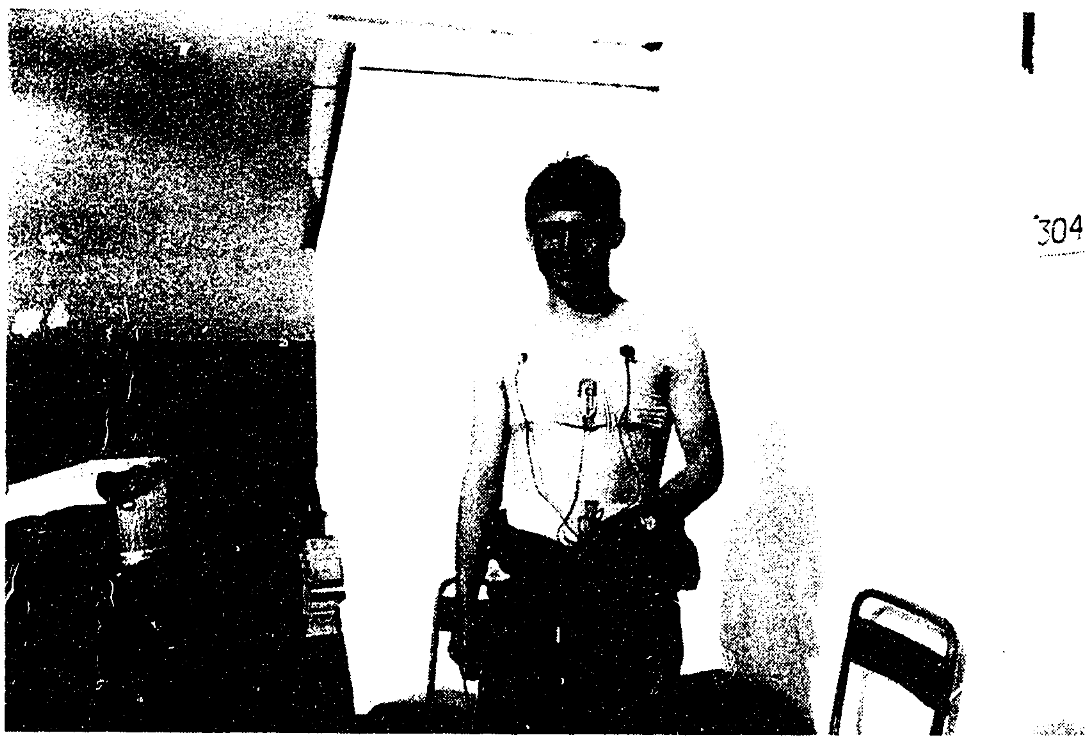


Plate 3

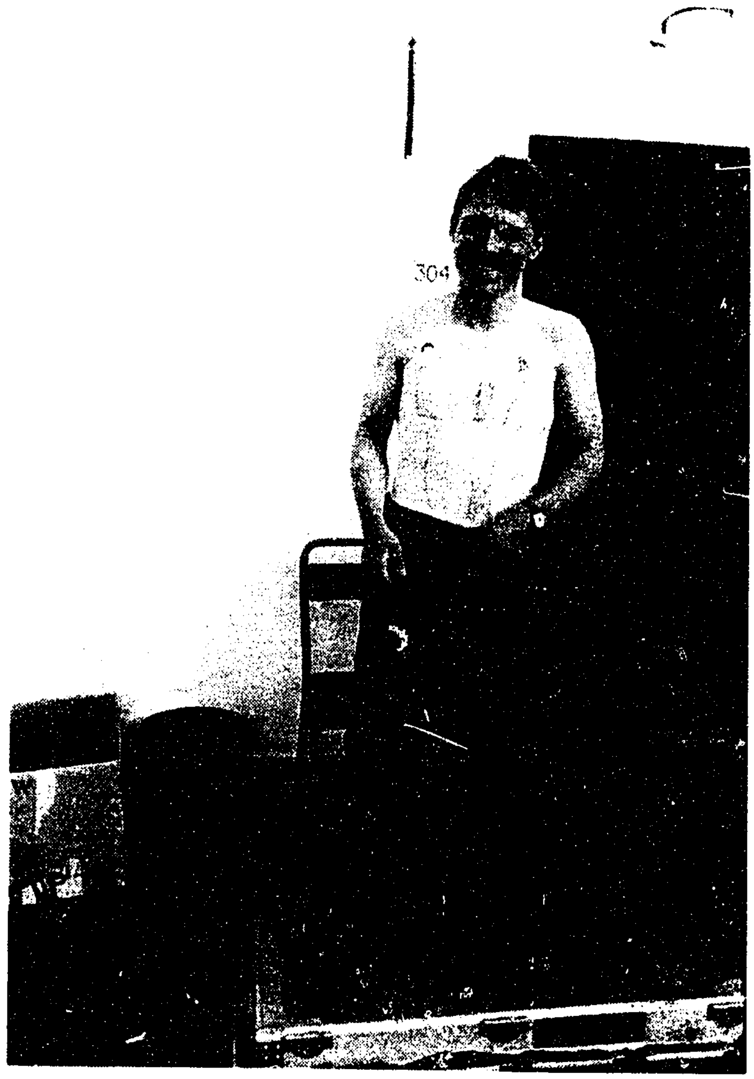


Plate 4

The leads from the chest and abdominal sensor bands, and the cardiac leads were connected to the portable monitor which was strapped around the waist (Plates 5 &6), making the recording equipment unobtrusive. Once everything was attached and calibrated the internal clock of the Vitalog PMS-8 was synchronized to the experimenter's watch.

Data Collection

Calibration

For all of the subjects, calibration of the respiratory and cardiac parameters were conducted as outlined in the Vitalog manual (1983). Attachment of the instrumentation and the calibration for each subject lasted twenty to thirty minutes. Since the subjects were to be seated during most of the day, the calibration was performed while the subjects were comfortably seated.

Experimental Phase

Monitoring for the experimental phase was instigated immediately after the calibration was completed. Continuous monitoring of the respiratory parameters and heart rate occurred through out the rest of the day and the data was stored by the Vitalog microprocessor.

During the experimental phase the subjects' behaviors and actions were recorded by the experimenter. As well there were periodic inquiries as to the nature of the subjects' feelings and reactions to the day's events.

Baseline

Upon completion of the the interview the subjects were asked to find a place of their choice away from the rest of the SARTechs and focus on deep diaphragmatic breathing. The baseline recording session lasted twenty minutes.

Plate 5

Plate 6

Perceptual Data Collection

Information on what the situation was like for the individual was collected by asking the subjects questions pertaining to what their thoughts and feelings were during the day, and, if they had adopted any coping strategies. In order to assess the anticipatory effect of encountering a stressor, the subjects were questioned periodically through out the day as to the nature of their thoughts.An in depth interview was conducted by the experimenter at the end of the day in order to gather information on how the subjects may have perceived the day's events and what factors in the individual's life may have influenced their reactions to the situations. The individuals were questioned about life events (problems), coping strategies, support systems and extracurricular activities.

Observational Data

Throughout the day a record was kept of the subjects' behaviors and of events which had transpired. As a result a more complete picture of what had occured to the individual for the duration of the day was collected (Appendix A).

Sensation Seeking Scale

In order to determine if there was any relationship between an individual's inclination to sensation seek, as measured by Zuckerman's (1976) scale, the subjects were asked to fill out the scale prior to the onset of the baseline recording session.

D. Data Analysis

Visual Data Analysis

The traditional method for analyzing times series data has been by the visual comparison of data points. Changes in the data were measured by the differences in magnitude and the rates of the changes. Kazdin (1982) presented data characteristics that must be identified in order for visual inspection to be useful:

1. changes in means reflects shifts in the average rate of behavior between phases,
2. changes in level demonstrate whether or not the intervention produced reliable changes,

which shows a discontinuity of behavioral intensity from the end of one phase to the beginning of another,

3. changes in trend reveal systematic increases or decreases over time,

4. latency of change shows a lag in changes in behavior as a result of the intervention, and,

5. the variablity of responses within a given phase is also important.

A drawback of visual data inspection is that changes may occur which do not appear to be significant visually. Therefore the visual (Rouse, 1984).

In order for a time series analysis to be applicable for a single case design a large number of data points must exist within each experimental phase. The large number of points allows for the existence and pattern of serial dependency

E. Internal Validity

The internal validity of a study is represented by the degree to which the change in behavior can be attributed to the intervention. Threats to internal validity include history, testing, instrumentation, statistical regression, selection bias, maturation and experimental mortality. However in a single case time series design experimental mortality and selection bias do not constitute threats. In a single case design if the subject is lost there is no data to be accumulated therefore there would be no study. As well you cannot bias the selection of the response data as you can the selection of subjects, since all the physiological data comes from the same individual. Therefore the threats to internal validity that a single case time series design must contend with include history, maturation, testing, statistical regression and instrumentation.

Events that occur during the couse of the experiment which are not part of the manipulation constitute the history threat. One drawback of field research is the lack of control, which is sacrificed in order to have a more realistic setting. In this study the recording sessions occurred continuously for one day for each subject during which time the experimenter was with the subjects the whole time. Any extraneous events were recorded and the subject's were questioned about the effects of the disruption. Due to the nature of the study, and the continuous monitoring of the parameters any unforeseen situations that occurred had the potential of eliciting some type of response, which were considered as another potential stressor.

Any natural processes within the subjects that occur as a result of time passing are considered threats due to maturation. Since the subjects were monitored continuously for one day maturational changes are insignificant. However, there are circadian rythmns that may have influenced the level of physiological activity, The rythmns differ for each individual thereby making it difficult to control for. By having continuous monitoring at very small increments numerous "baselines" were established from which the physiological changes were compared.

Internal validity threats due to testing involve the effects that repeated testing has on the results. The study had two different interventions, therefore could not be considered as having any testing threats associated with it. However, exposure to the first situation may have had an effect on the individual's response to the second situation. The nature of the study allowed for the contingency. Since stress is considered a rubric and a result of a person-environment interaction, any factors that could have potentially influenced a response had to be considered, even previous experiences and extraneous stimuli.

Statistical regression, which occurs when scores tend to approach the mean, also constitutes a threat to internal validity. Physiological variables have floor and ceiling effects, which do not allow for an infinite range of scores (Kazdin, 1980). An analysis of the results may not show any statistically significant effects, for scores near the maximum or minimum limits of the scale, because there was little room to increase or decrease in magnitude. Although the results could be insignificant statistically, there could be clinical or practical applications.

If there are changes in the instrument calibration and/ or lack of agreement between observers, a threat to internal validity due to instrumentation exists. Since the same equipment was being used on each subject and was calibrated by the same experimenter, the threat due to instrumentation was minimal. As well, the subjects were connected to the equipment continuously, diminishing the possibility of fluctuating calibration settings, since the equipmemt only had to be calibrated once.

F. External Validity

> "Generally, it is better to ensure that the experiment is internally valid, since it would be meaningless to generalize the results of an internally invalid study" (Kratchowill, 1978; p 11)

Due to the specific nature of the inquiry, the generalization of the results to other individual is limited. If, however enough studies are done using the same methodology a pattern of response may become apparent if the same parameters and variables are used. On the other hand, the results may not be useful to other individuals but they may be applied to the same individual in different situations. If more research is conducted on the same individual major variables that influence that particular individual's response may become more evident.

RESULTS

A. SUBJECTS

There were three subjects involved in the study. All subjects were military personel who were in training to become Search and Rescue Technicians (SARTechs). The trainees were all males who had been in the military for eight years or more. Subject A was 27 and had been in the armed forces for ten years. Subject B had been in the military for eight years and was 25 years old. Subject C was 28 years old and had been in the military for 10 years.

Since the purpose of the study was to determine how the experience of stress may have influenced the subject's respiratory and cardiac responses, a number of variables had to be taken in to account. Due to the complexity of the interaction between the variables, the measuring techniques employed provided varying forms of information. The challenge of analyzing the different forms of data resides in providing a homogeneous foundation from which the analysis can be made.

Stress is an individual phenomena. The most appropriate means for analyzing the data examinations resulted in elevated heart rates and subjective reports of elevated stress among college students. The subjects in the current experiment were required to write a one hour examination based on the treatment of trauma. In addition to the written test the other two testing situations could be classified as normatively stressful. Medical simulations and oral presentations are also stressful. Within the context of the medical simulation there are events which may alter the degree of sympathetic tone in the individual providing the care. One such incident is the recovery of the victim to consciousness; one of the vital signs for assessing the degree of trauma is the level of consciousness. Another is the successful insertion of an Intravenous glucose solution. Therefore if a victim regains consciousness it is an indication that the administered treatment may be improving the individual's condition. As well a conscious victim may be able to provide the SARTech with information that will allow him to provide more beneficial treatment resulting in a decrease in stress.

Closely related to the effectiveness of the treatment is the successful insertion of an IV. In a medical simulation the trainees have two chances to perform the operation. If one is not successful there is the added knowledge that there is only one try left. An unsuccessful IV insertion in a hypovolemic shock victim greatly reduces the chances of survival of the victim. In the medical simulation the examinees realize this and are evaluated on all aspects of the treatment.

Changes in sympathetic and parasympathetic tone are mediated by neocortical input as well as other variables. In response to new information people assimilate the information to prepare for possible outcomes. Pre- and post situational analysis were provided to determine the effect of anticipatory vigilance on the subjects for each situation. Apart from the medical simulation the analysis also will identify the pre and post levels of respiratory parameters and heart rate for the written examination, the oral board exam and a control session.

Intersituational comparisons were made for each scenerio and the control session and between the situations themselves.

B. Subject A

Physiological data

Control: 1612hrs- 1634hrs

(Figure 1 ; Appendix B)

For the duration of the control session the subject was asked to sit in a comfortable position and focus on deep diaphragmatic breathing. The heart rate for the su ject during the control situation demonstrated a fluctuation from 50.8 to 84 beats/ minute(bts/min). The rate decreased from 95 to 60 for the first minute. For the next seven minutes the heart rate oscillated between 50 and 80 with the majority of the time displaying a heart rate around 60. During the eighth minute of the control session the subject displayed a heart rate increase up to 90 with it dropping down to 50 within the span of 15 seconds. Following the last increase the rate remained at approximately 50 for the duration of the relaxation session.

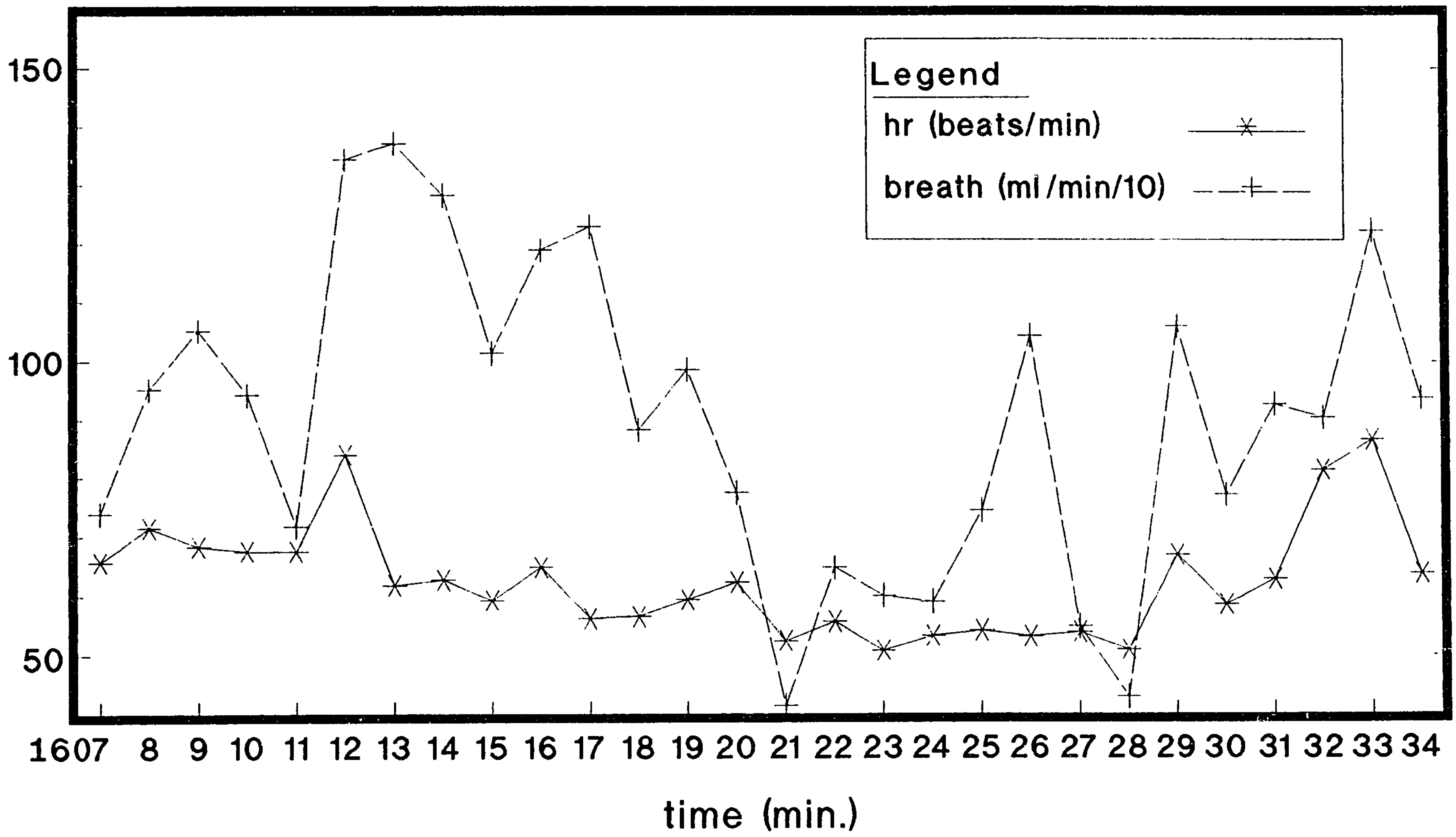
The breathing pattern of the subject was also initially erratic. The breaths were voluminuous, of short duration and paradoxical for the first 3.5 minutes of the control. The breaths also had a tendency to be more inspiratory in nature. For the following 3.5 minutes the breathing became less sinuous and began to be more evenly distributed between inspirations and expirations. The next 5 minutes of the session revealed a breathing pattern which consisted of short, shallow breaths with inspiratory and expiratory volume exchanges being equally distributed. The next three minutes (1625hrs- 1628hrs) demonstrated longer and deeper breaths.

Medical Simulation: 0922hrs- 1015hrs

(Figures 2a,b ; Appendix B)

The testing session for Subject A began at 0922hrs. At 0919hrs there was a marked increase in heart rate the time the subject was being briefed about the nature of the accident. The rate increased from 64 to 83.4 and then jumped to 128.7 as the team was carrying the sled to the accident site. Upon reaching the scene at 0929hrs the rate declined rapidly to 99.3.

Subject A (fig 1)
Control 1612–1634hrs

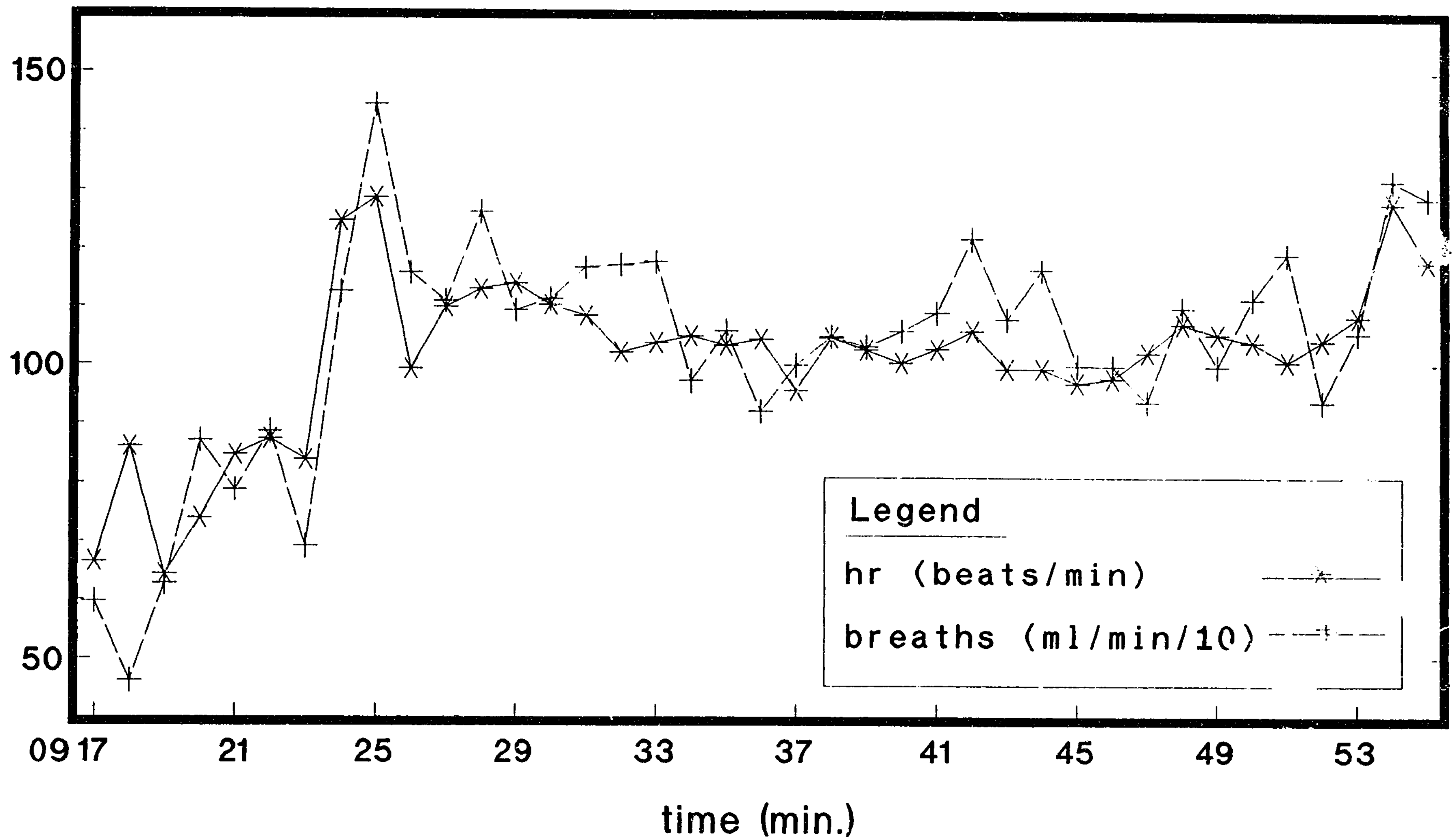


During the victim assessment phase of the operation the rate accelerated to 114. Following the assessment the rate declined slightly to 102.2. Prior to the insertion of the Intravenous needle the subject's heart rate increased slightly 104.4 (0936hrs). The initial IV placement was unsuccessful and there was an increase in heart rate from 95.7 to 104.4 at the time the subject was locating a second placement site. At 0942hrs there was a second attempt at an IV insertion. It was also unsuccessful. There was a slight decrease in heart rate from 105.7 to 96.8 following the attempt at which point the subject regained consciousness and was speaking. The victim was given oxygen as the subject was talking to him. At 0949 hrs the victim started to hyperventilate at which point Subject A performed the neccessary operation and the breathing returned to normal. The heart rate at that time remained approximately at 105 and remained there while the survival team was discussing patient transport to the stretcher. The subject demonstrated a steady heart rate until 0954hrs when the patient was being transferred to the stretcher.The heart rate increased up to 127.8. There was a steady decrease in the rate to 103.4 over the next six minutes. Subject A began examining the extremities for breaks and the heart rate increased to 105.7. During the extremity check the victim was complaining about the treatment he was receiving (1001hrs). A decline in heart rate occurred during the next minute to 97.5 and hovered between 97.5 and 100.8 for the next five minutes at which point there was an increase up to 109.5 (1007hrs). There was a decline in the heart rate from 109 to 89.4 as the team members compared notes. The rate increased up to 101.7 as the subjects approached the physician for the debriefing at1012hrs. The heart rate declined to 91.6 during the next 5 minutes and became very erratic as the subject was packing the sled. There was an increase from 84 to 116.4 as the subject carried the sled back to the equipment room (1023hrs). While restocking the equipment and during the debriefing by the examining officer the heart rate reached a low of 73.4 over the next 37 minutes (1101hrs) at which point the subject went outside to sit in the sun and wait for the written examination to start.

The pattern of respiration throughout the medical simulation demonstrated a large degree of paradoxical breathing and a sinuous breathing pattern. Throughout the simulation

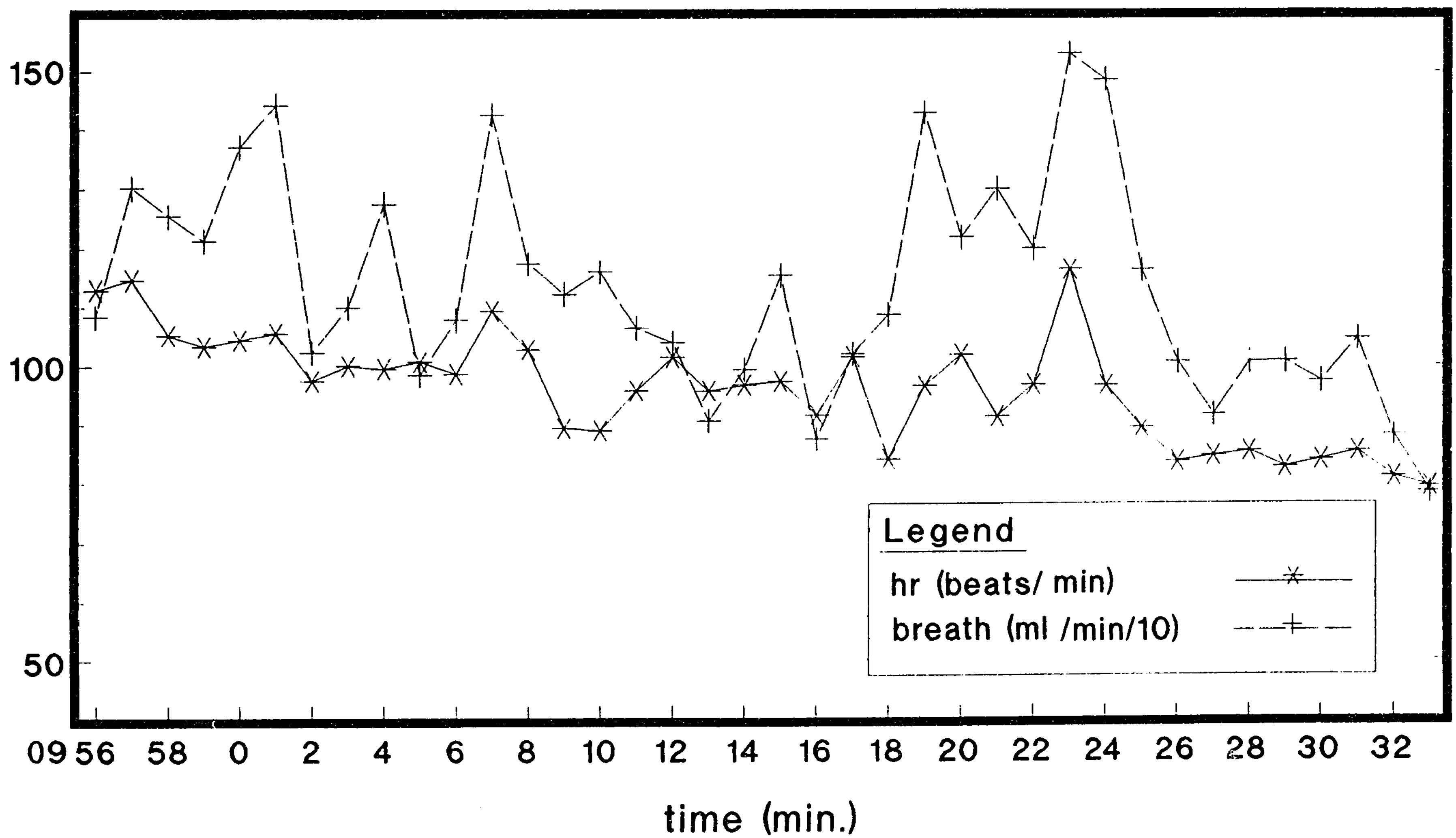
Subject A (fig 2a)

Medical Simulation 0922-1015hrs



Subject A (fig 2b)

Medical Simulation 0922–1015hrs



the breaths were rapid and fairly volumous. Upon completion of the simulation (1022hrs) and during the repacking there was a much more regular breathing pattern with average tidal volumes between 541and 880mls. The incidence of paradoxical breathing events was much less frequent from 1032hrs to 1100hrs, 46 compared to 106 during the time between 0926hrs and 0954hrs.

Written Exam: 1118hrs- 1150hrs

(Figure 3 ; Appendix B)

Events which transpired during the written exam were at 1118hrs when the students were told, as a joke that the exam was twenty pages long; a sargent walked into the room at 1126hrs and a fellow SARTech asked a question at 1130hrs. There were no noticable changes in any of the subject's physiological readings as a result of the circumstances. The exam bell rang at 1116hrs. At 1115hrs the subject's heart rate was 77.7. The heart rate gradually declined over the next two minutes to 65 where it remained fairly constant for the duration of the exam. There were occasional increases in HR, which reached upto 90, over the course of the exam .

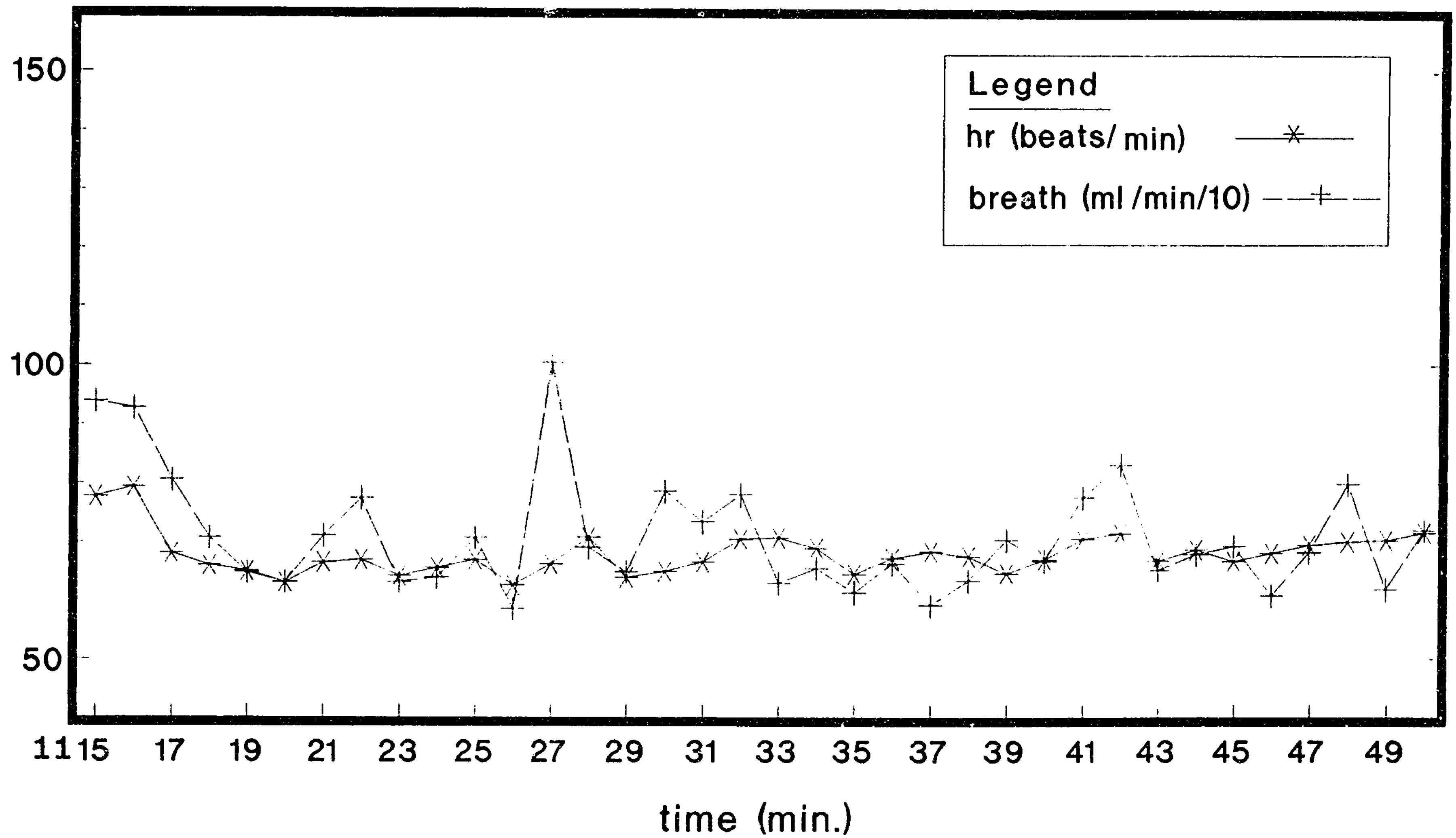
Accompanying the increases in heart rate were paradoxical breathing episodes and in some instances, large inspiratory changes. The breathing pattern demonstrated an even distribution of tidal volume during inspirations and expirations. Paradoxical breathing was most often associated with a sinuous breathing pattern. The respiratory tracing demonstrated a fairly constant breathing pattern with a tidal volume range from 585 to 1006.1 mls and short regular breaths. There were 12 fairly evenly dispersed, deep inhalations over the 32 minutes it took the subject to complete the exam.

Oral Examination: 1447hrs- 1507hrs

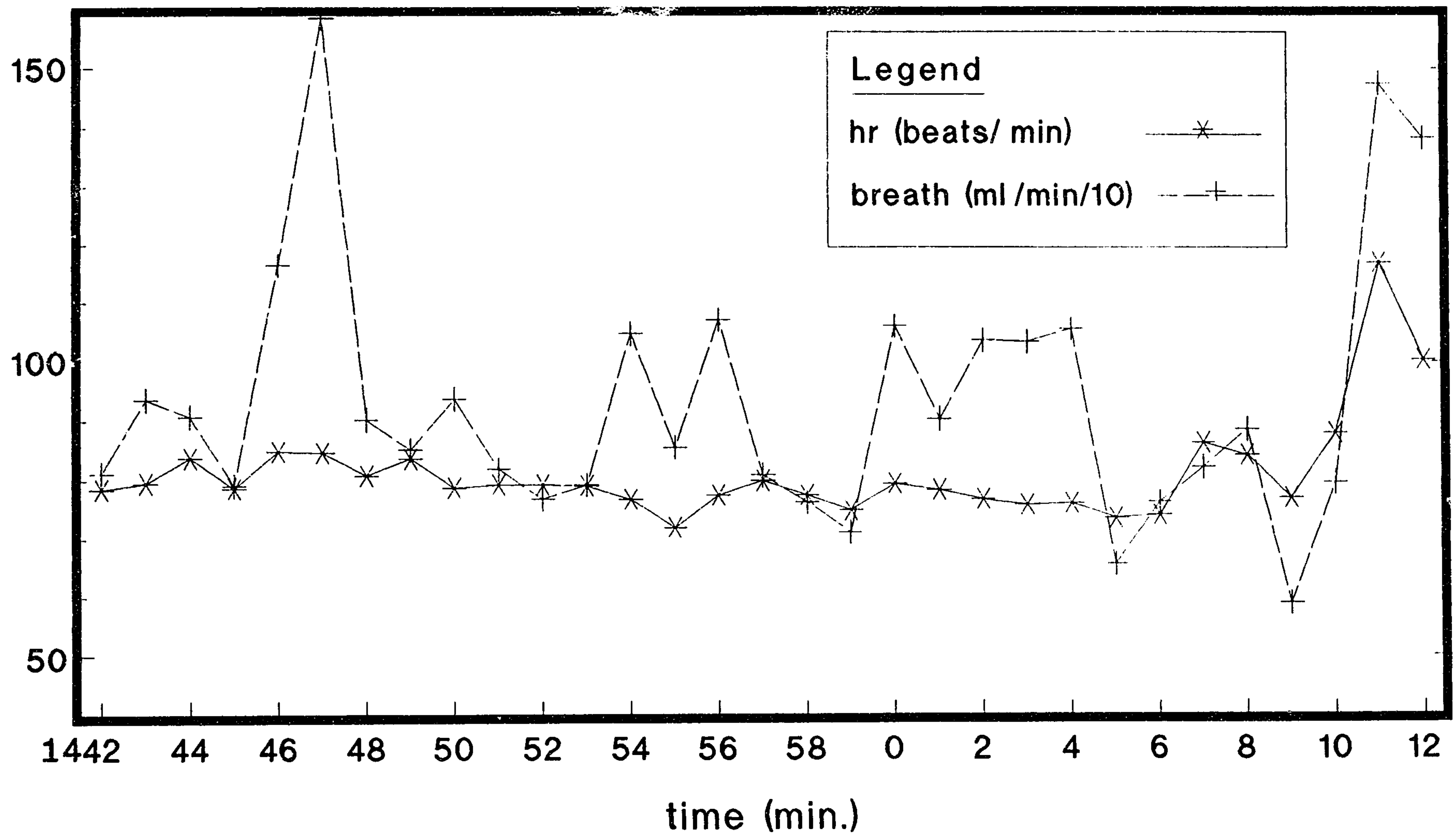
(Figure 4 ; Appendix B)

At 1341hrs the subject found out that he was going in for the oral examination. There was an increase in his heart rate from 80.8 to 88.5 and then declined slightly to 85.4. The subject's oral exam started at 1435hrs at which point the heart rate accelerated from

Subject A (fig 3)
Written Examination 1118–1150hrs



Subject A (fig 4)
Oral Examination 1447–1507hrs



84.5 to 93.4. For the duration of the oral examination the heart rate fluctuated between 71.9 and 93.4.

From 1435hrs - 1444hrs the respiratory pattern demonstrated by the subject was predominately paradoxical and rapid. There was also a sinuous pattern evident. For the duration of the oral examination the volume exchanged varied widely. Sometimes it consisted of large inhalations followed by shallow exhalations; other times it was shallow inhalations followed by large exhalations.

Medical Simulation vs Control

The range of heart rates during the control session was from 50.8 to 88 beats/min. As the relaxation session progressed there was a general decline in the rate from 61 to the low of 50.8 at which point there was a slight increase prior to the subject getting up to move. As the subject stood up and proceeded to move the heart rate demonstrated a steady increase up to 88. The frequency of the changes in heart rate were minimal as indicated by the constant line and blocked off areas during the session. (Fig. 5).

In contrast the range of the subject's heart rate during the medical simulation was 83.8 to 128.7. The largest change occurred during the first three minutes of the simulation during which time the team was carrying the sled to the accident site. The heart rate fluctuated more frequently during the medical simulation than the control session and were in general of greater magnitude. The average heart rate for the control was 59.0 with a standard deviation of 7.4. The average for the medical simulation was 104.1 with a standard deviation of 9.2.

The range of the volume of air exchanged during the control session was 415.7 ml/min to 1371.6 ml/min. The average was 892.6 with a standard deviation of 292.1 mls. There was a trend towards a decreasing exchange of air as the relaxation session progressed.

The incidence of paradoxical breathing events was much higher in the medical simulation time frame for any given twenty minute interval when compared to the control session.

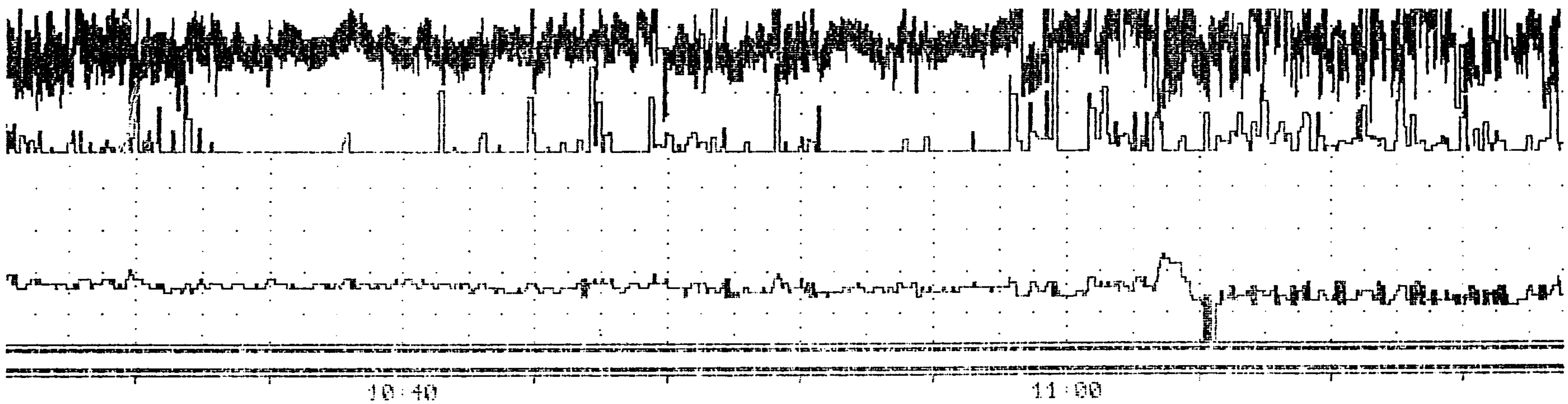


Figure 5

The rate of breathing was fairly comparable between the two sessions. Toward the middle of the relaxation session the breathing frequency declined for three minutes and was associated with slightly larger tidal volumes.

The pattern of breathing between the two events also differed. The volume of air exchanged during the control session was fairly constant in that the inspirations were balanced by the expirations resulting in a straight line (Fig. 5). The medical simulation breathing pattern was more erratic and had episodes of a sinuous type pattern. The pattern was characterized by a low volume of exchange resulting in a steady increase in lung volume immediately followed by similar shallow breaths with a decrease in lung volume, with the cycle being repeated (Fig. 6).

Written Exam vs Control

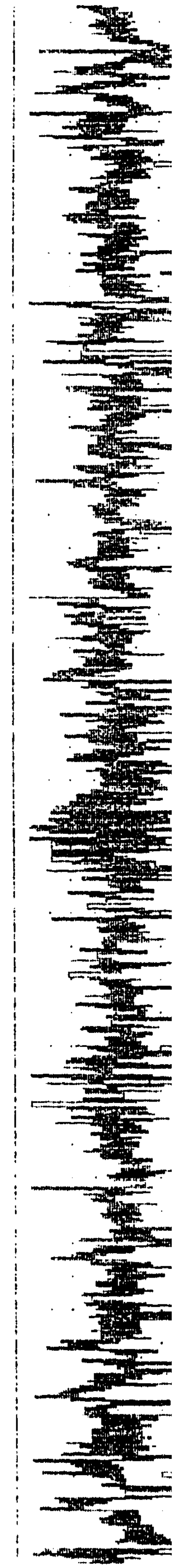
The volume of air exchanged and heart rates during the written exam were generally higher than the control situation. The heart rate declined as time passed in the control session but remained constant in the examination. In both sessions there were no irregularities. The average for the control session was 59.0 with a standard deviation of 7.40 in a range from 50.8 to 80.4. The corresponding values for the written examination were 67.30 and 2.50 and a range from 62.5 to 71.5.

The breathing pattern was similar for both sessions in that there was a consistent exchange of air between inspiration and expirations, ie. no sinuous wave patterns existed. The latter portion of the written examination (1138hrs to 1150hrs) did demonstrate a shallow wave pattern (Fig. 7).

There were fewer paradoxical breathing events during the controlled breathing session compared to the written examination. The paradoxical events were associated with a change in breathing pattern and/ or volume in both sessions.

Oral Examination vs Control

The heart rates demonstrated by the subject were higher during the oral examination than the control session. The average for the oral exam was 78.30 with a standard deviation



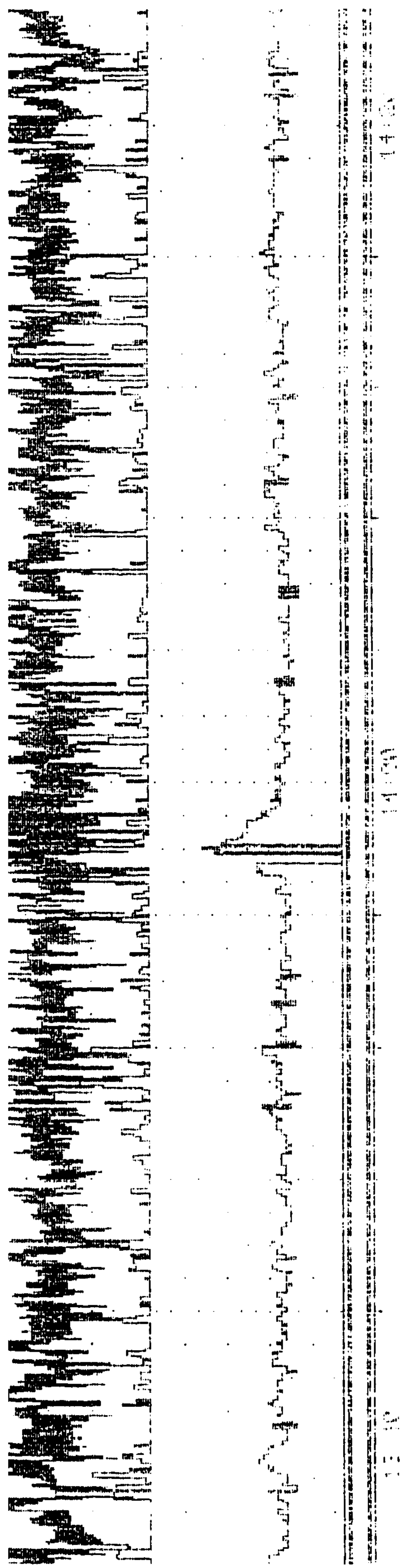


Figure 6

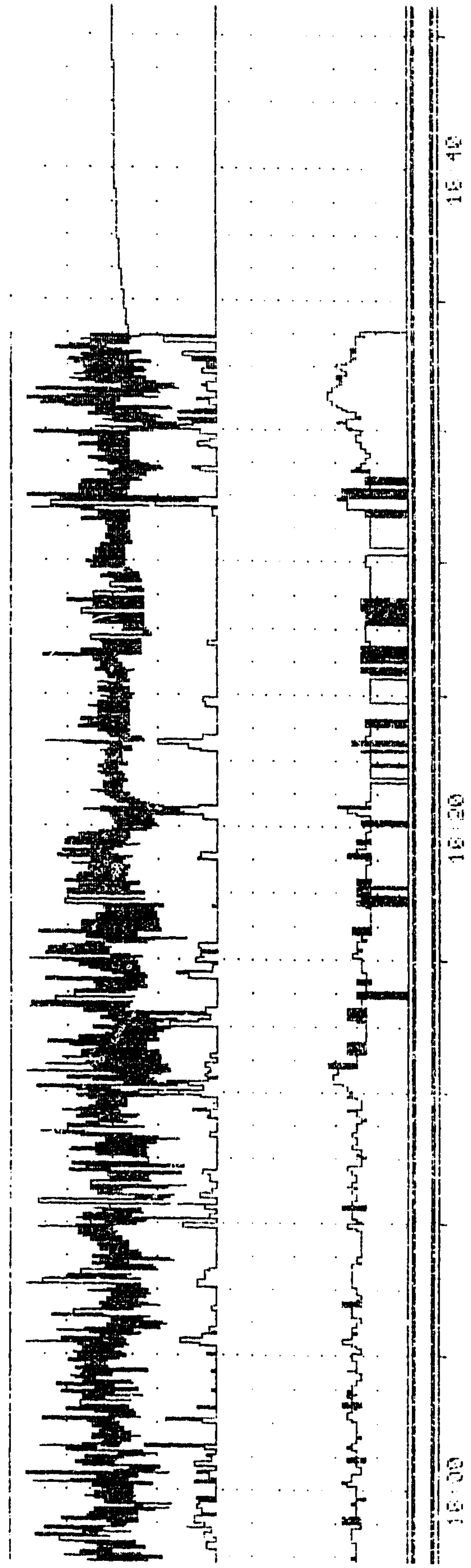


Figure 7

of 3.50 and a range of 71.9 to 86.3. For the control period the average was 59.0 and the standard deviation was 7.40. The range was 50.8 to 84.0. In both situations the rate was regular with the oral board examination resulting in a steady heart rate fluctuating between 71.9 and 86.3 compared to the slight but steady decline demonstrated in the control period.

The range of volumes during the oral examination ranged from 656.9 to 1585.6 ml with an average of 916.3 and a standard deviation of 194.0 compared to the relaxation sesssion which had a range of 430.8 to 1371.6 with an average of 892.6 and a standard deviation of 292.1, indicating the volumes were slightly higher in the oral examination. The breath duration in the oral examination was longer than the duration during the control session.

There were also more frequent paradoxical events evident in the oral examination than the relaxation session; the events were also of greater magnitude. The breathing pattern was irregular during the oral board as well as sinuous in nature. In contrast the pattern of breathing for the control time period was regular and linear.

Medical Simulation vs Written Examination

The heart rates during the written portion of the testing were lower than those values obtained during the medical simulation. The range was 62.5 to 71.4 with an average of 67.3 and a standard deviation of 2.5, compared to 83.8 to 128.7 as a range with an average of 104.1 and a standard deviation of 9.2 for the medical simulation.

The breathing pattern during the medical simulation was more irregular and demonstrated larger sinuous wave patterns than the written examination. There were also more and larger paradoxical breathing events during the medical simulation than the written exam. The range of breath volumes measured during the medical simulation was 692.2 to 1443.8 mls. The average was 1119.3 and the standard deviation was 144.3 mls. Analogous values for the written exam were; range 585.0 to 1006.1, average 696.8 and a standard deviation of 84.8 mls.

Medical Simulation vs Oral Examination

The heart rate range for the medical simulation was from 83.8 to 128.7 with an average of 104.1 and a standard deviation of 9.2. The oral examination elicited heart responses ranging from 71.9 to 86.3, the average for the time period was 78.3 with a standard deviation of 3.5. The heart rate fluctuated more frequently and to a larger degree during the medical simulation when compared to the oral examination.

The incidence of paradoxical breathing events was greater during the medical simulation than the oral examination. Both situations elicted large lung volume exchanges as well as sinuous breathing patterns. The exchange volumes ranged from 692.2 to 1443.8 in the medical simulation with an average exchange of 1119.3 with a standard deviation of 144.3. Oral board values demonstrated an average exchange volume of 916.3 with a standard deviation of 144.3 and a range from 656.9 to 1585.6 ml. The rate of breathing during the oral examination was slower than the medical simulation.

Written Examination vs Oral Examination

The heart rates which occurred in the written exam were slightly lower than the during the oral board. The range for the written exan was 62.5 to 71.5. The average was 67.3 with a standard deviation of 2.46. In contrast the range for the oral examination was from 71.9 to 86.3 with an average of 78.3 and a standard deviation of 3.5.

The respiratory indices were markedly different. The oral examination elicited more paradoxical events of greater magnitude, and, a more irregular breathing pattern than the written. More sinuous patterns were evident during the medical examination as were larger volumes of air exchange. The range was from 656.9 to 1585.6 ml with an average of 916.3 and a standard devaition 194.0. The written exam had a volume exchange ranging from 585.0 ml to 1006.1 with an average of 696.8 with a standard deviation 84.8.

Interview Results

Subject A's situation was slightly different from that of Subject B and Subject C. The medical simulation was perceived as a do or die situation for him. The subject indicated that realizing the circumstances made the medical simulation a source of stress. The subject experienced a poor night's rest as a result of having this knowledge. Subject A felt that the effects of knowing his predicament was limited to the medical simulation. He indicated that the knowledge of possible failure did not have an effect on how he felt during the written exam or the oral board examination. The trainee also stated that he felt he was not "excited" enough and that may be a reason why he did not do well.He did however feel apprehensive about the oral examination.

When the subject was questioned about the nature of the coping strategy he employed, he indicated that no strategy had been used. When questioned further about the way he dealt with past problems, the subject indicated that he internalized alot of his problems. Scenerios and the mistakes that could be made were the focus of the internalizations.

The subject reported that during the past week there had been, and, currently were, personal problems in his life. The issue was not pursued any further.

Subject A reported he felt the course was stressful. The aspect he found most stressful were the inconsistencies in the information provided by the instructors. This led to a feeling of frustration with the instructors. The difficulties encountered in the course were shared with the other SARTech trainees, but, personal problems were not shared with his colleagues; they were discussed with his girlfriend. The subject continually emphasized that when dealing with problems he thinks alot about them, and dwells on the problem for a while, then he diverts his attention.

Subject A indicated he did not perceive himself as a perfectionist. He stated he engaged in a number of different activities. Not all of them are physical in nature. The subject tried to run on either Saturday or Sunday.

Generally, the subject indicated he felt he should have been more anxious than he was. He indicated his level of activation was too low and he should have been more excited. The individual could not however explain why he may have felt that way and stated he was not dealing with the day's exams any differently. Subject A did not think he performed well in the medical simulation. In an attempt to speak with the subject after the simulation, it was evident he did not wish to talk about the situation. He was very quiet and withdrawn.

The subject's impression of the written examination was fairly positive. He felt he did well and only had made a few errors.

The subject's reaction to the to the oral board was that it was a major stress. He felt he did not do well and failed.

Sensation Seeking Scale V

The results of the test demonstrated the subject's overall score was 21, placing the subject in the 51 percentile of scores obtained by Zuckerman on college students (1976). The individual scales demonstrated a score of 10 on the Thrill and Adventure Seeking sub scale(TAS); 5 on the Experience Seeking subscale (ES); 4 on the Disinhibition subscale (DS) and 2 on on the Boredom Suceptibility subscale (BS). These results indicate that the overall score for the subject was not high. Subscale scores were not high except for the TAS score.

C. Subject B

Physiological Data

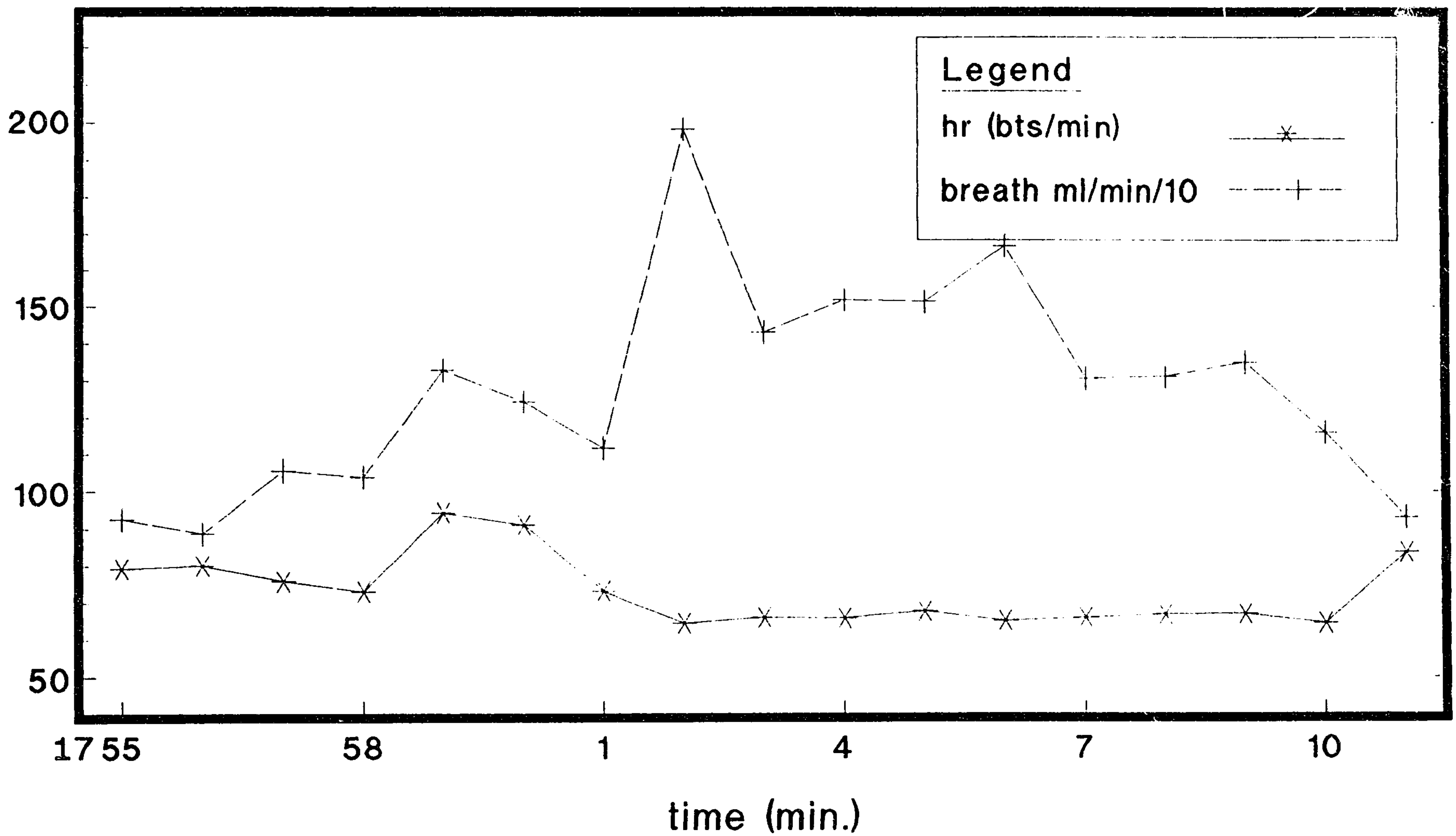
Control Session: 1700hrs- 1712hrs

(Figure 8; Appendix C)

Walking to his choice of a place to relax the subject demonstrated a heart rate of 94.6 (1659). When the subject sat down the heart rate began to decrease; it dropped to 64.3 within two minutes. For the following eight minutes the heart rate ranged 64.3 to 67.6. Due to time constraints the control session was reduced to eleven minutes. At 1511hrs the heart rate increased to 83.8 as the subject moved to the main classroom. The average for the eleven minutes was 66.6 with a standard deviation of 2.44 within a range from 64.3 to 83.8.

At 1659hrs when the subject was moving, the average volume of his breaths was 1327.3 mls. As the subject started his session the respiratory volume declined for the next two

Subject B (fig 8)
Control 1701– 1711hrs



minutes to 11[illegible]. The following minute (1702hrs) revealed an increase in volume up to 1979.5 mls. There was a reduction in average tidal volumes to 1428 in the next minute. A slight increase prevailed over the following three minutes to a volume 1665.0 mls. (1706hrs). A decrease in volume to 1159.8 occurred from 1707hrs to 1710hrs. As the subject got up to move the tidal volume decreased to 932.5. The range of average tidal volumes during the control session was 932.5 to 1979.5. The average was 1434.2 with a standard deviation of 240.6.

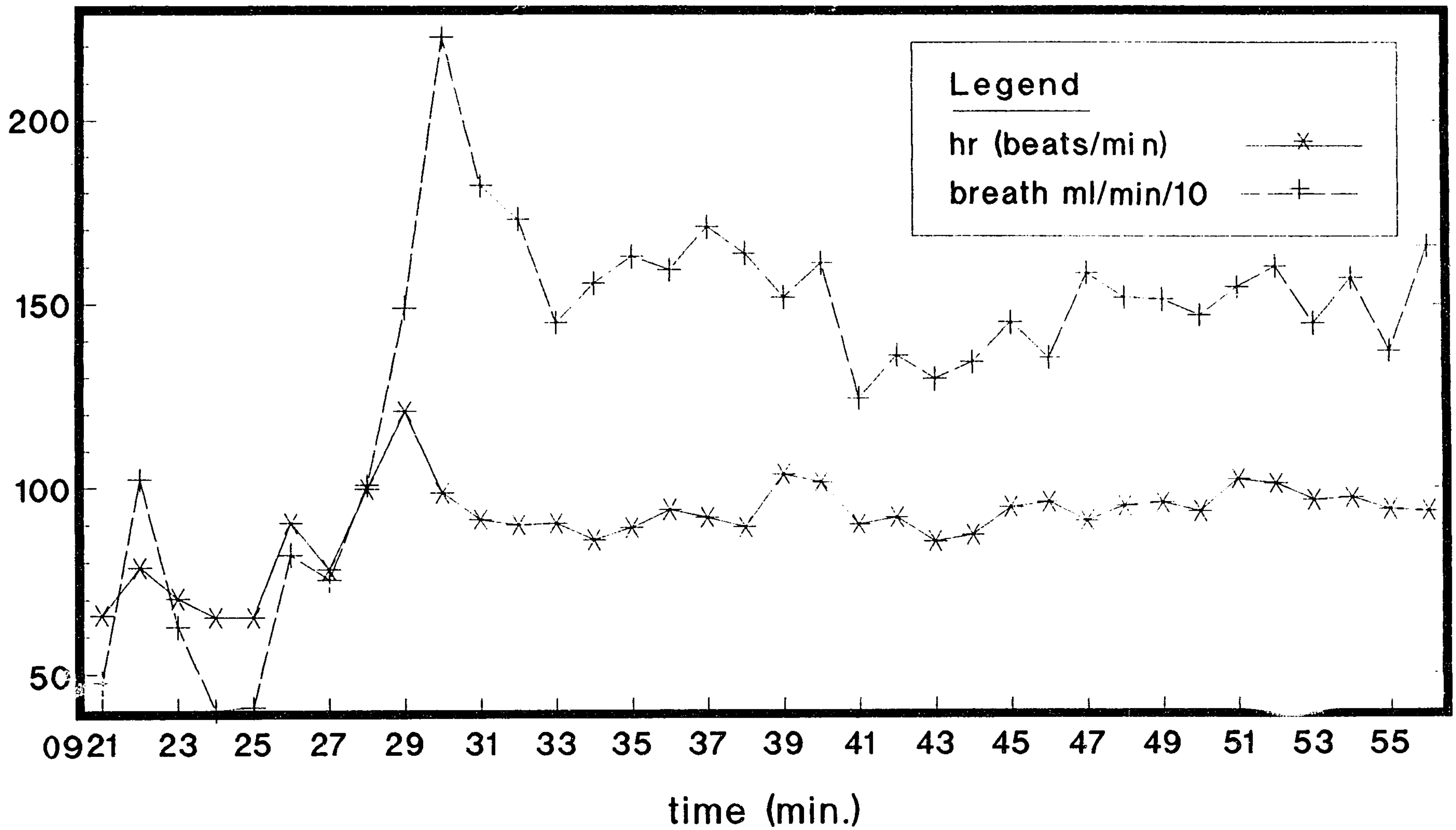
The rate of breathing was fairly rapid. At the onset of the relaxation session there were three large paradoxical events which spanned the two minutes from 1700hrs - 1702hrs. The following ten minutes demonstrated ten paradoxical events of smaller magnitude than those present during the first two minutes. The breathing pattern during the eight minutes from 1702hrs - 1710hrs was sinuous in nature with the largest sine wave occuring from 1702hrs - 1709hrs. As the subject prepared to move larger paradoxical breathing events occured.

Medical Simulation: 0926hrs- 1042hrs

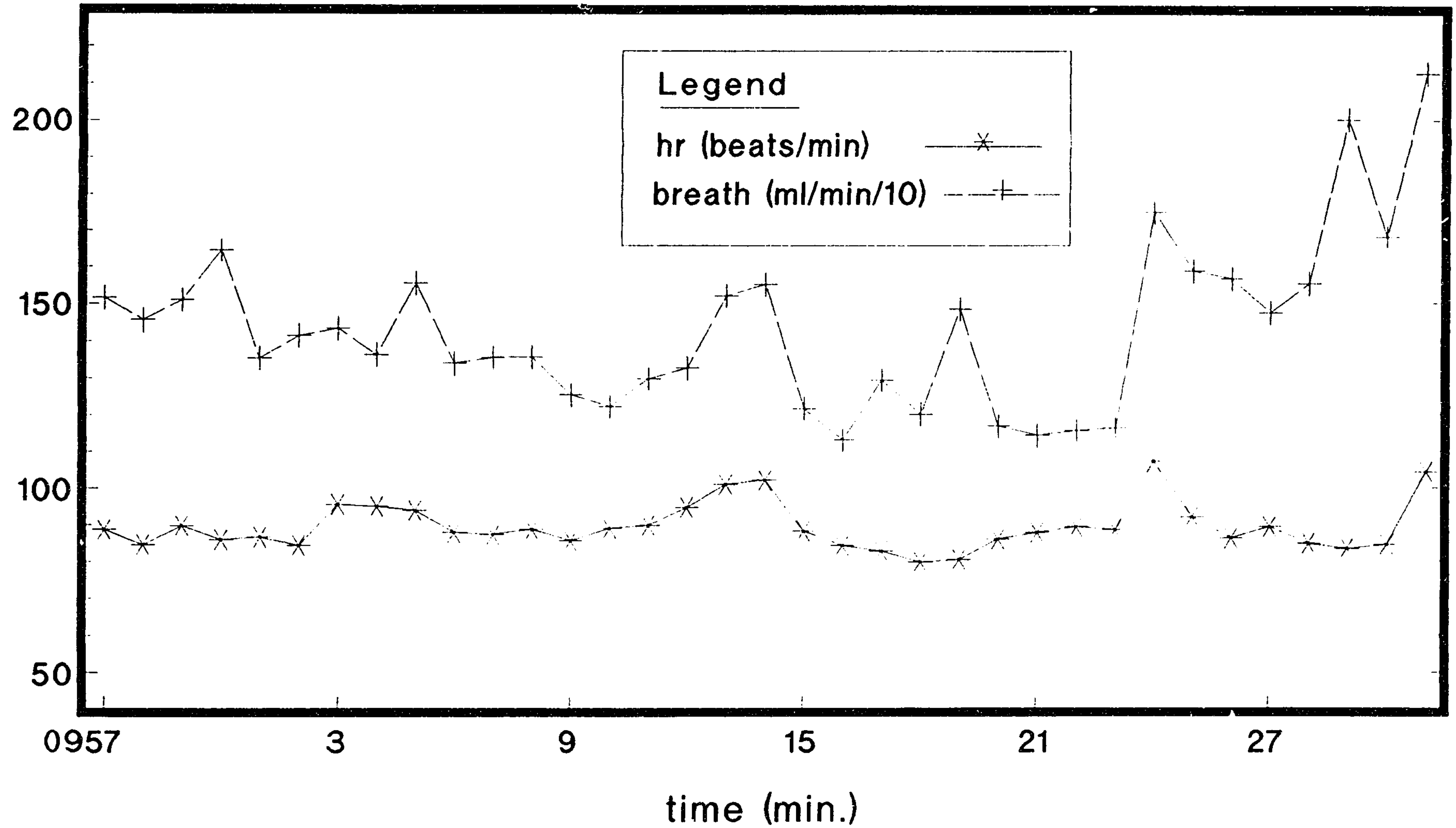
(Figures 9a & b; Appendix C)

At 0926hrs the subject was debriefed along with his partner as to the the nature of the accident. There was an increase in the subject's heart rate from 65 at 0925hrs to 90.5 at 0926hrs. A drop in heart rate was evident during the next minute and was substantially increased upto 121.0 (0929hrs) as the subject helped to carry the sled to the accident site. At 0930hrs the heart rate dropped to 98.6. From 0930hrs there was a fairly constant decline in heart rate from 98.6 to 85.8 until 0935hrs at which point the rate began to accelerate up to 103.5 (0939hrs). The cycle of decelerating and accelerating heart rates was repeated until 0952hrs at which point there was a decrease to a fairly constant rate between 84.6 and 97.00. At 1013hrs the heart rate increased to 101.2 and 102.4 the following minute. After the interuption the previous cycle occurred two more times until 1042hrs when the simulation ended with the subject carrying the sled back to the equipment room. The average heart rate for the medical simulation was 91.02 with a standard deviation of 6.01.The range was 78.0 to

Subject B (fig 9a)
Medical Simulation 0926- 1029hrs



Subject B (fig 9b)
Medical Simulation 0926- 1029hrs



121.0. Both values occurred within two minutes of one another early in the simulation.

The volume changes during the inspiration and expiration paralleled the changes in heart rate quite closely, with a one minute lag in respiratory response to heart rate changes. The range of volumes of air exchanged during the medical simulation was 753.1 to 2226.1. This range occurred within a four minute time frame (0926hrs- 0930hrs). The range from 0931hrs until 1042hrs was less severe; 1132.9 to 2002.5 with an average of 1427.3 and a standard deviation of 172.2. The medical simulation was also characterized by continuous large paradoxical breathing events which persisted throughout the entire simulation.

Written Examination: 1117hrs- 1135hrs

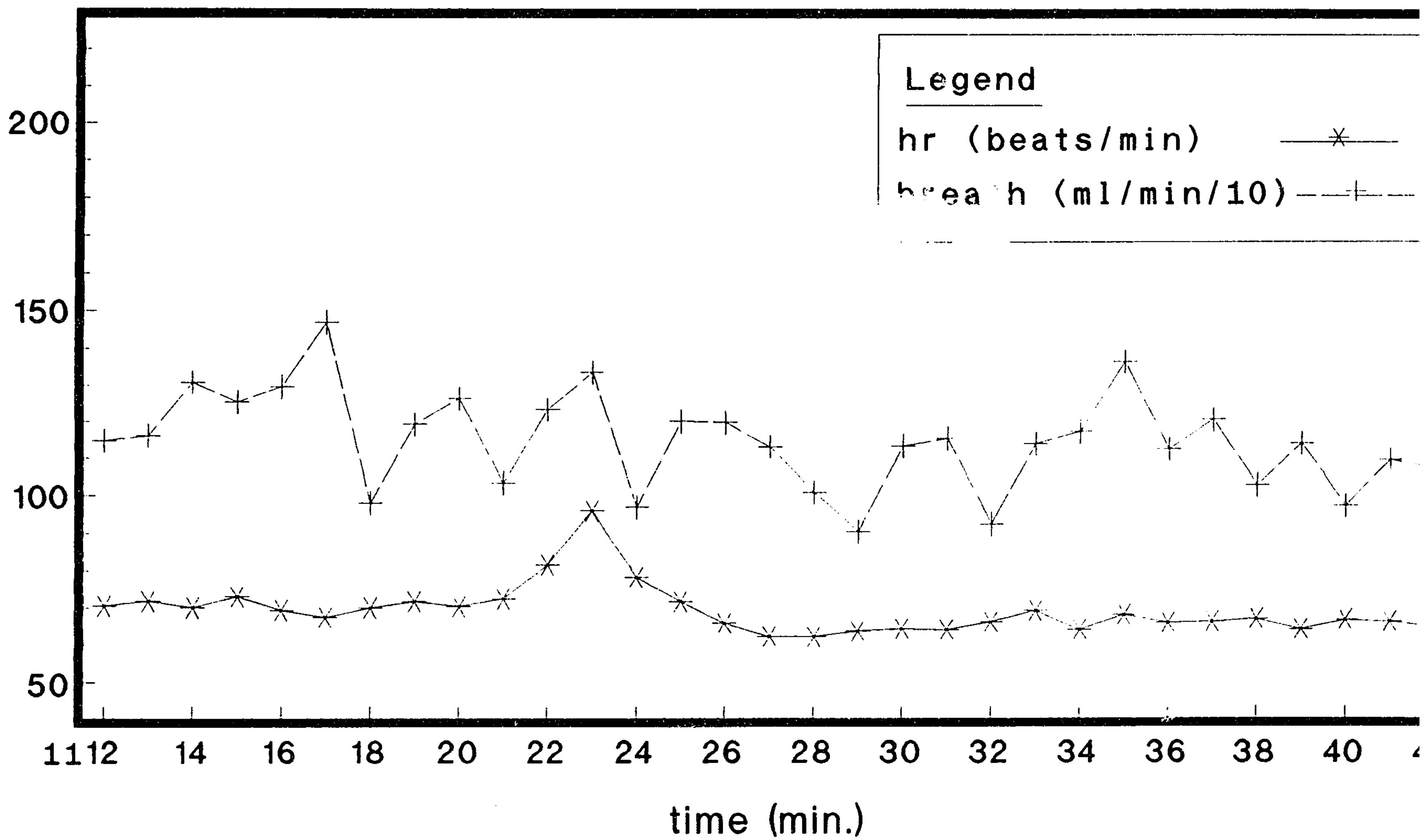
(Figure 10; Appendix C)

Prior to the onset of the written exam the whole class was sitting outside in the sun. Subject B exhibited a heart rate of 67.6 at 1117 hrs. The average during the entire examination was 71.4 with a standard deviation of 7.3 and a range of 62.3 to96.1. At 1121hrs the rate increased from 72.5 to 81.7. A peak heart rate of 96.1 was attained at 1123hrs. The following minute there was a decrease to a rate of 78.5 and there was a continual decline to 62.3 superseded by an acceleration up to 68.3 at 1135hrs when the subject completed the exam. The following minute the heart rate was 66.1 and remained below 67.0 for the next seven minutes and then increased slightly up to 88.4 and then decreased to 75.0. The heart rate remained in the low 70's for the majority of the time until lunch.

The tidal volumes during the same time period consistently paralleled the heart rate fluctuations. At 1055hrs the tidal volume was 1483.5 and increased upto 1785.8 at 1057 hrs. From the onset of the exam the tidal volumes fluctuated from 907.3 to 1470.6 with an average of 1146.3 and a standard deviation of 152.83. As with the heart rate the volume of air exchanged dropped during the last minute. The decrease in air exchanged was from 1363.1 to 1124.2.

The breathing pattern was continually paradoxical during the written examination. For the first three minutes of the exam there were two events. Following the onset there were constant paradoxical breathing events of varying magnitude. The large paradoxical breathing

Written Examination 1117- 1135hrs



events were associated with an elevated heart rate (see appendix C, time: 1120- 1122; 1143-1144) through out the day.

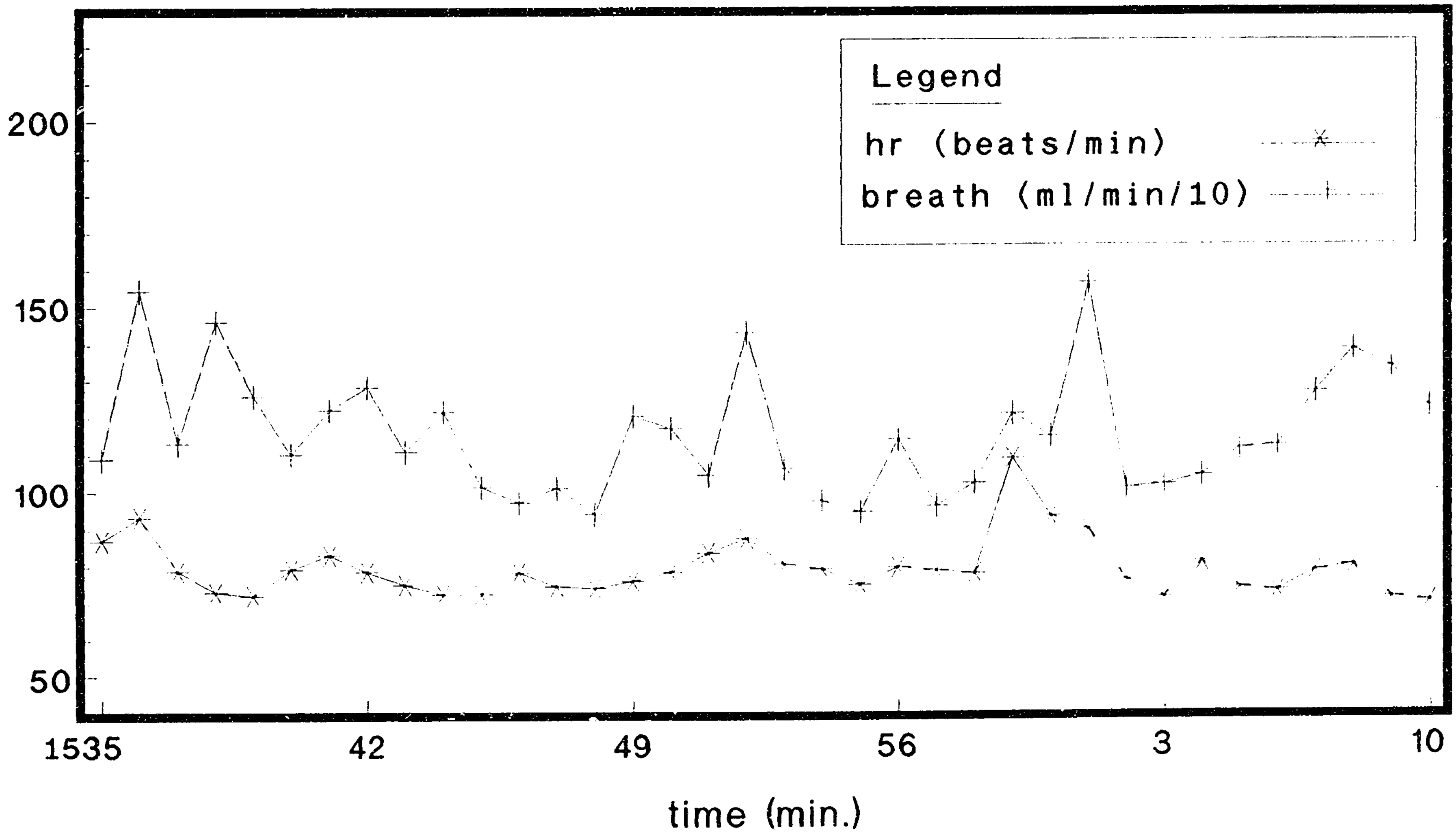
Oral Examination: 1535hrs- 1610hrs

(Figure 11; Appendix C)

The subject was sitting outside in the sun until he went for his oral exam at 1535 hrs. Within the first two minutes of the examination an increase in heart rate upto 93.4 was displayed. Following the increase there was a decrease in heart rate in the next three minutes to 72.2 . From 1541 hrs to 1545 hrs the subject's heart rate declined from 83.0 to 72.5. The next minute demonstrated an increase up to 78.6 followed by a decrease to 74.0 in the next two minutes (1548 hrs). An acceleration in heart rate occurred from 1548 hrs to 1552 hrs. The change went from 74.0 to 87.4. A decrease to 75.0 was elicited over the duration of the next three minutes (1555 hrs). An increase to 79.7 at 1556 hrs was followed by a slight decrease to 78.0 by 1558 hrs. The heart rate jumped 30 beats per minute during the next minute to 108.9. The acceleration was followed by a decrease in heart rate to 71.3 at 1603 hrs. At 1604hrs the heart rate increased to 81.0 and slowed to 73.0 by 1606 hrs. The next two minutes demonstrated an increase to 79.9. The final two minutes of the oral examination revealed a decrease to 70.2. The heart rates for the oral board examination ranged from 70.2 to 108.9. The average for the time frame was 79.3 with a standard deviation of 7.7.

The tidal volume pattern demonstrated a trend that generally paralleled heart rate fluctuations. For the first 13 minutes of the oral board there was a general decrease in exchange volumes. A peak exchange volume of 1545.1 was recorded at 1536hrs and a low of 940.6 occurred at 1548hrs. The increases in tidal volume occurred at 1539hrs with an increase from 1132.2 to 1461.5; between 1540hrs and 1542hrs an increase from 1100.7 to 1282.6 was evident. A decrease to 1108.1 was recorded during the next minute and was followed by an increase to 1216.4 by 1544 hrs. The next two minutes demonstrated a drop to 971.4. There was a slight increase to 1010.4 at 1547 hrs, but this was trailed by a decrease to 940.6 at 1548hrs.

Subject B (fig 11)
Oral Examination 1535– 1610hrs



From 1548hrs until the end of the oral board the average volume of air exchanged was erradict and paralleled heart rate fluctuations. From 1548 hrs to 1549 hrs there was an increase from 940.6 to 1203.4. The average volume exchanged decreased to 1045.1 by 1551 hrs. 1552 hrs was characterized by a sharp increase to 1433.3. The period between 1552 hrs and 1555 hrs demonstrated a decrease in tidal volume from 1433.3 to 945.6. The average tidal volume during the next minute increased 1141.7 and then declined to 961.4 by 1557hrs. Over the following two minute time span the average volume increased to 1209.1. A slight drop to 1148.8 and a sharp rise to 1566.5 characterized the time frame from 1600 hrs to 1601hrs. A rapid decline to 1009.7 occurred during 1602 hrs. From 1602hrs to 1608hrs the average tidal volume increased from 1009.7 to 1385.8. For the entire oral board the average volume of air exchanged was 1160.1 with a standard deviation of 164.5. The range was 940.6 to 1566.5.

The general breathing pattern was very erratic; there was no evidence of any particular pattern. There were 49 continuous paradoxical events. The implication by the term "continuous" is that the paradoxical breaths during the examination were not interspersed by "proper" breathing; one paradoxical event flowed in the next.

Control vs Medical Simulation

The average heart rate for the medical simulation was 91.0 with a standard deviation of 6.0 within a range of 78.0 to 121.0. In contrast the corresponding values for the control period were 66.6 and 2.4; the range was 932.5 to 1979.5. Although the control session was of short duration, there was no time frame of equal length throughout the simulation where the average heart rate was as low as the mean of the relaxation session. Also, the heart rate during the medical simulation was constantly fluctuating, in contrast to the linearity displayed during the deep breathing session.

The stark differences evident in heart rates between the two time frames did not exist for the breathing variables. The average tidal volume for the control session was 1434.2 with a standard deviation of 240.6 in a range from 932.5 to 1979.5. For the medical simulation the average tidal volume was 1427 with a standard deviation of 172.2 within a range of volumes from 753.1 to 2226.1. Although the respiratory changes paralleled heart rate changes, to a certain degree during the medical simulation, the respiratory volumes did not demonstrate similar charateristics during the control session. There was a general decrease followed by a sharp increase in the volume of air exchanged approximately halfway through the control session.

The number and degree of paradoxical events varied greatly between the two situations. For any given length of time during the medical simulation, equal to the length of time of the control period, there were many more continuous and extreme paradoxical events. In contrast, the paradoxical events were much less severe and seperated by periods of proper breathing during the control situation.

Control vs Written Examination

The written examination elicited an average heart rate of 71.4 with a standard deviation of 7.4 within a range of 62.3 to 96.1. The control period measurements were 66.6 for an average and a standard deviation of 2.4. The first eight minutes of the written examination demonstrated heart rates beyond the range of the first standard deviation of the control session. However, the remaining ten minutes revealed heart rates which were with in the first standard deviation of the relaxation period.

The respiratory parameters differed between the two sessions as well. The average tidal volume during the written examination was 1146.3 with a standard deviation of 152.8mls and a range from 907.3 to 1470.6. The control session had an average of 1434.2 with a standard deviation 240.6 and a range of 932.5 to 1979.5 mls. Within the eleven minute time frame of the control session there was little time to determine if a pattern was established based on one minute increments. The general trend of decreasing volumes exhibited in the relaxation session was not evident during the written examination. The written exam did however demonstrate five episodes of low volume breaths.

The paradoxical events differed between the two sessions. The first four minutes of the written examination demonstrated a paradoxical pattern similar to the latter part of the control session; there were a few episodes of low volumes interspersed with bouts of proper breathing. The following fourteen minutes of the written exam elicited a much different pattern of paradoxical breathing than the first part of the examination and the control session. It was characterized by by large continuous paradoxical events during the minutes of 1122 hrs to 1126 hrs. The remaining time revealed continuous events but the degree of volume exchanged was much less than the preceding five minutes.

Control vs Oral Examination

The average heart rate for the oral examination was 79.3 with a standard deviation of 2.4 within a range from 70.2 to 108.9. The pattern of heart rate was characterized by accelerations followed by decelerations; a cycle which occurred five times during the oral examination. The control session displayed a fairly constant heart rate with an average of 66.6 and a standard deviation of 2.4. The range was 64.3 to 83.8. For any given time during the oral examination the heart rate did not fall with in the first standard deviation of the control session; it was always higher.

The trend in breathing pattern was similar in both situations. There was a general decline in the average breath volume as the situations progressed. The average breath volume for the oral board was was 1160.1 with a standard deviation of 164.5 and a range of 940.6 to 1566.5 mls. The corresponding values during the control session were 1434.2 and 240.6; with a range of 932.5 to 1979.5. The trend in decreasing volumes during the oral examination changed to an increase in volume at 1548hrs and lasted for four minutes and became irregular for the duration of the examination (see Appendix C time: 1548 - 1610).

There were more and larger paradoxical events for any eleven minute period contained with in the oral examination than during the relaxation situation. The pattern of volume of air exchanged during the oral examination was irregular in that there was no distinct sinusoidal wave evident.

Medical Simulation vs Written Examination

The average heart rate for the medical simulation was 91.0 with a standard deviation of 6.0 with the values varying between 78.0 to 121.0. For the written exam the average was 71.4 with a standard deviation of 7.3 and a range of 62.3 to 96.1. The medical simulation was characterized by a number of large fluctuatuions. The pattern of the heart rate during the written exam demonstrated a slight decline over the duration of test with one major deviation. Seven minutes after the exam started there was a drastic increase in heart rate up to 96.1 and a decline to values below the norm three minutes after. The remainder of the test demonstrated a fairly linear pattern.

Both situations elicited an irregular pattern of volume exchange. The written exam demonstrated larger and more rapid fluctuations than the medical simulation, but the absolute volumes were greater during the medical simulation. The average volume was 1427.3 with a standard deviation of 172.2 with th[illegible] ranging from 753.1 to 2226.1 for the medical simulation. The average volume exchanged during the written examination was 1146.3 with standard deviation of 152.8 with volumes fluctuating from 907.3 to 1470.6 mls.

The magnitude and frequency of the paradoxical events were much greater during the medical simulation than during the written examination.

Medical Simulation vs Oral Examination

The pattern of heart rate fluctuations were similar in both scenarios. The changes which occurred were gradual; larger increases or decreases transpired over two to three minutes. The changes were more rythmic and consistent during the written examination than the medical simulation. Generally, the changes which occurred during the medical simulation did so to a larger degree. The average heart rate during the accident scenerio was 91.0 with a standard deviation of 6.0 with rates falling between 78.0 and 121.0. The corresponding values for the oral examination were 79.3 and 7.7 with a range of 70.2 to 108.9.

The pattern of average tidal volume changes were similar in both situations. But the volumes exchanged during were consistently larger. The average for the medical simulation was 1427.3. The standard deviation was 172.2. For the oral examination the average volume of air exchanged was 1160.1 and the standard deviation was 164.5. Ranges for the events were 753.1 to 2226.1 for the medical simulation and 940.6 to 1566.5 for the oral board.

The degree of paradoxical events were much greater in the medical simulation than the oral examination. The events were also continuous throughout the medical simulation.

The oral examination was characterized by paradoxical events of lower magnitude, interspersed with periods of proper breathing.

Written Examination vs Oral Examination

The heart rate pattern for the written exam was fairly linear except for one major deviation which occurred six minutes after the exam started. The average heart rate during the written examination was 71.4 and had a standard deviation of 7.3 the values ranged between 78.0 to 121.0. Heart rates during the oral board session demonstrated rolling fluctuations with a slight trend towards increasing rates from the beginning of the session to the end. The average heart rate for the oral board exam was 79.3 and had a standard deviation of 7.7 within a range of 70.2 to 108.9.

Both sessions demonstrated sharp changes in the average tidal volumes as well as paradoxical events. The written exam revealed two distinct phases. Initially there were few paradoxical events with the majority of the time having the subject engaged in proper breathing. Following the fourth minute the number and degree of paradoxical breathing events increased dramatically. The oral board demonstrated a more consistent pattern of paradoxical events. Events were interspersed with bouts of proper breathing and were smaller than those elicited during the written exam. The volume fluctuations were relatively regular and demonstrated slight sinuous pattern during the oral. An average of 1160.1, standard deviation 164.5 and a range from 940.6 to 1566.5 mls characterized the oral. Corresponding values for the written examination were 1146.6, 152.8 and 907.3 to 1470.6 mls for the range. standard deviation was 164.5.

Interview Results

Subject B indicated he did not find any of the situations stressful. He was under no external pressure to perform well in the medical simulation and felt that the written exam went well. The oral exam was also perceived as non stressful even though he thought he made some mistakes.

The subject found the course stressful but it was not the most stressful thing he has done. He was confident about each situation.

The coping mechanism that the subject employed during the day was that of blocking bothersome thoughts. The subject stated that approximately one- half hour before an encounter he avoided thinking about the upcoming situation.

The individual had a fairly well established support system. One of the subject's friends was a SARTech who had gone through the course and was a good source of information. As well, there was a substantial familial support system; the subject made frequent calls to his family.

The individual's background was a major source of information that helped the subject deal with the stressors of the course. Prior to becoming a SARTech trainee the subject was a sergeant. Part of his responsibilities as a sergeant included instructing enlisted men. According to the subject the military had a rigid educational format outlined. Since he was an instructor, the subject perceived himself as being adequately prepared to deal with the cycle of stressors that the instructors imposed upon the students. As well, the subject believed that he could relate to the officers better than the other trainees because he was an officer at on time.

Subject B indicated that becoming a SARTech was very important to him.

The personal life of the subject was full of potentially stressful situations. He was going through a divorce and was in the middle of a custody battle for his daughter. The subject stated that he did not think about the custody battle and is confident he will be successful in his bid.

The subject did not engage in any structured exercise regime. The course took up most of his time, and, all of his spare time was devoted to his daughter.

There was no apprehension on the part of the subject towards participating in the experiment. He felt there was a need to conduct research.

Being in the military all his life the subject felt adequately prepared to deal with the quirks of military life. Subject B stated that the military provided a good deal of support and that there are programs available for those individuals who require assistance for problems.

Through out the day the subject's behavior was calm. He continually interacted with the other trainees during the day.

Sensation Seeking Scale

Subject B had an overall score of 22 which would place him in the 59 percentile of the scores collected by Zuckerman (1976) on college students. The subject scored 7 on the TAS; 3 on the ES; 7 on the Dis and 5 on the BS subscales.

D. Subject C

Physiological Data

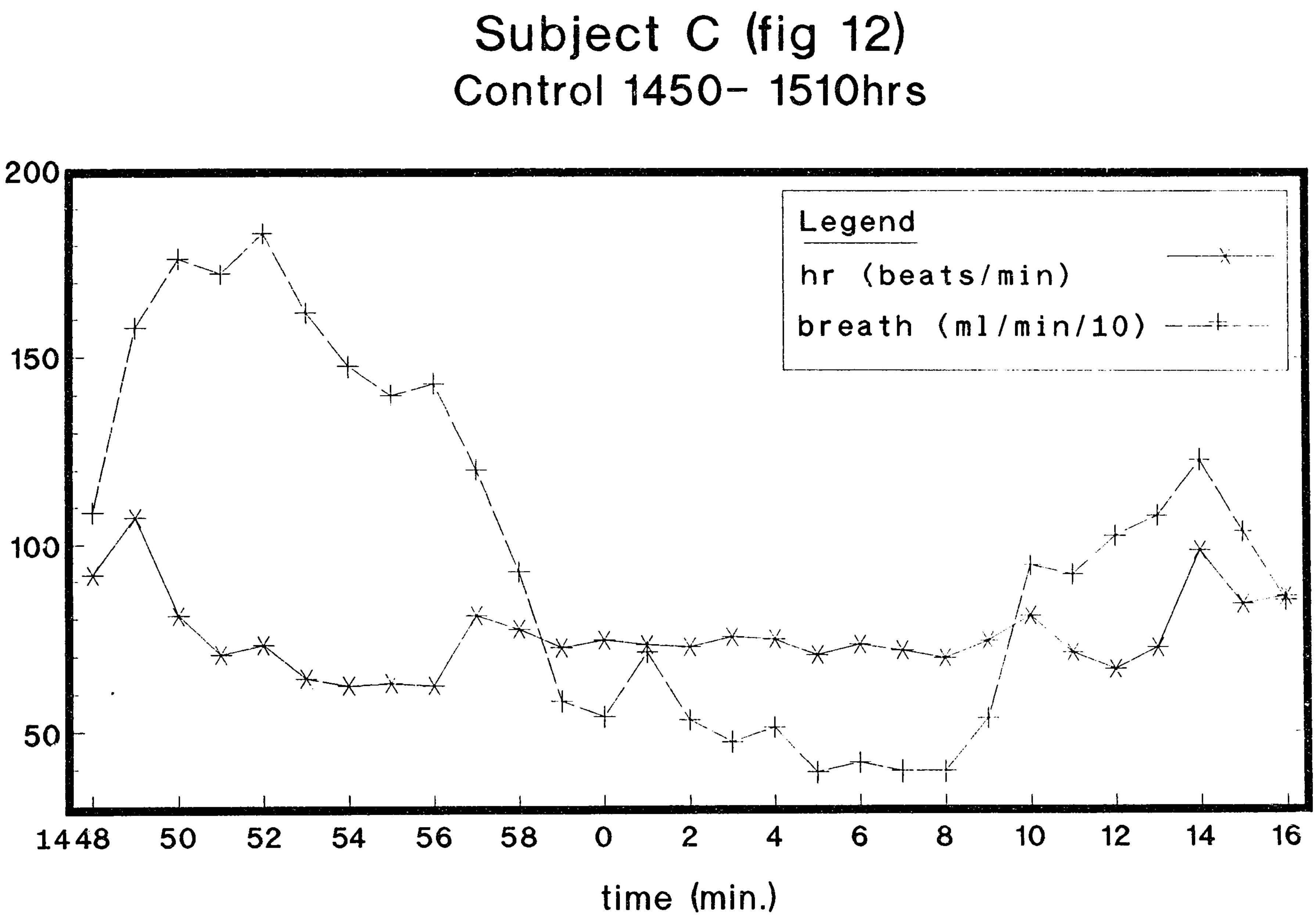
Control Session: 1450hrs- 1510hrs

(Figure 12; Appendix D)

The range of heart rates displayed by the subject fluctuated from 62.3 to 80.9. The average was 73.8 with a standard deviation of 7.7. At 1449 hrs the subject was told to go to a place of his choice to engage in a relaxation session for twenty minutes. As the subject started to move his heart rate increased to 107.3. As he approached the location and sat down the heart rate decreased rapidly to 80.8 in the first minute and more slowly over the next six minutes to a rate of 62.3. At 1457 hrs there was a sharp increase to 80.9. The following two minutes elicited a decrease to a rate of 72.3. The duration of the session was fairly constant, but it dipped as low as 69.5.

The respiratory parameters also demonstrated a dichotomous response in the control situation. Once the subject sat down deep regular breaths were the norm until 1458 hrs. At that time there was an event which stimulated a totally different respiratory pattern. From 1459 hrs until the subject began to move at 1510 hrs the volume of air exchanged decreased to a large extent. The range of the volumes for the first portion was 1201.8 to 1833.3 mls. The range for the duration of the session was 391.5 to 926.9.(The drop is evident in figure 12 and Appendix D). Although the volumes exchanged for each part of the control session differed greatly there was smooth and proper breathing in both portions of the situation. The only paradoxical breathing pattern was associated with the disturbance which occurred halfway through the session.

At the onset of the relaxation session the air exchanged tended to be more expiratory in nature and gradually became equally distributed between inspirations and expirations.


Subject C (fig 12)
Control 1450- 1510hrs
Legend
hr (beats/min)
breath (ml/min/10)
200
150
100
50
1448
50
52
54
56
58
0
2
4
6
8
10
12
14
16
time (min.)

Medical Simulation: 0917hrs- 1013hrs

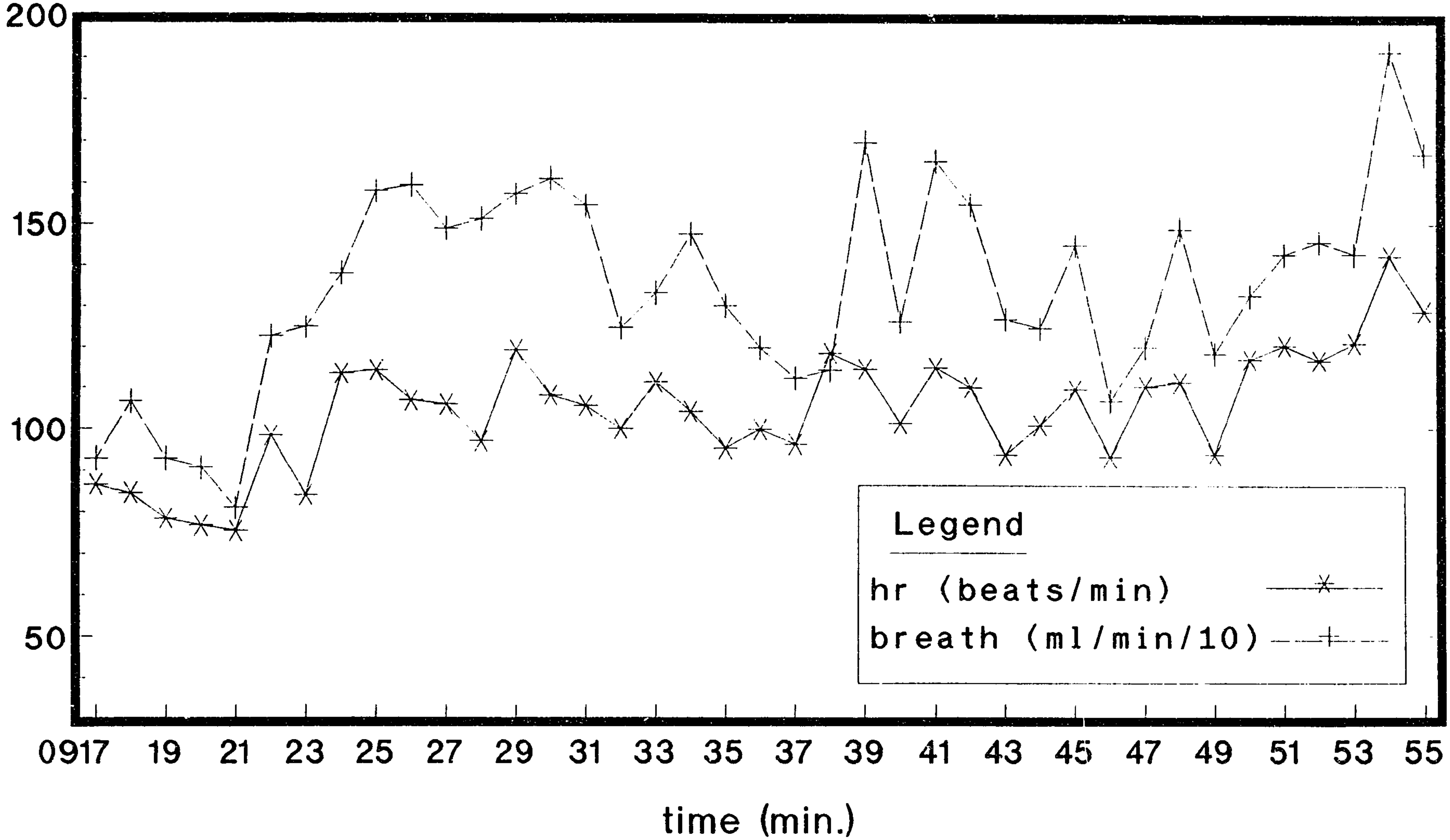
(Figures 13a & b; Appendix D)

Heart rates ranged from 75.5, which occurred at the onset of the simulation, to 142.3. Average heart rates for the time period was 104.9 with a standard deviation of 12.5. From 0917hrs to 0922hrs there was a decrease heart rate from 86.6 to 75.5. The next minute the heart rate increased to 98.4 followed by a decrease to 81.2. There was a rapid acceleration at 0924 hrs to 113.4. at which time the subject was carrying the sled. The following twenty-three minutes demonstrated decreases in heart rate over a range of 2- 4 minutes followed by sharp increases during the next minute. The pattern ended at 0948 hrs which corresponded to the time the victim responded favorably to the treatment. A decrease occurred with a sharp then gradual decrease over the following five minutes. At 0954 hrs there was a sharp increase to 142.3 with a decrease to 101.1 in the next three minutes as the subject was helping his partner move the victim from the accident site. The heart rate at 1005 hrs was 92.3. The heart rate accelerated the next minute to 104.9. A decrease to 81.4 occurred over the next three minutes. Gradual increases in heart rate occurred over the next two minutes preceded a rapid acceleration to 112.8 at 1012 hrs when the subject approached the physician for a debriefing. After the simulation ended the heart decelerated and remained fairly constant until 1020 hrs at which point there was an acceleration to 103.7. A drop in heart rate to 93.8 was followed by an increase over the next two minutes to a rate of 110.2.

The respiratory patterns paralleled the heart rate changes fairly closely. Respiratory volumes increased as heart rate increased. The range of the average exchange volume was 811.9 to 1914.7 which corresponded to the low and high range demonstrated by the heart rate. The average tidal volume was 1286.6 with a standard deviation of 261.6. There were frequent, for the most part continuous, low volume paradoxical breathing events through out the medical simulation. The overall pattern demonstrated a sporadic sinuous pattern. The amplitude of volumes fluctuated but there was no consistent rythmn.

Subject C (fig 13a)

Medical Simulation 0917- 1013hrs



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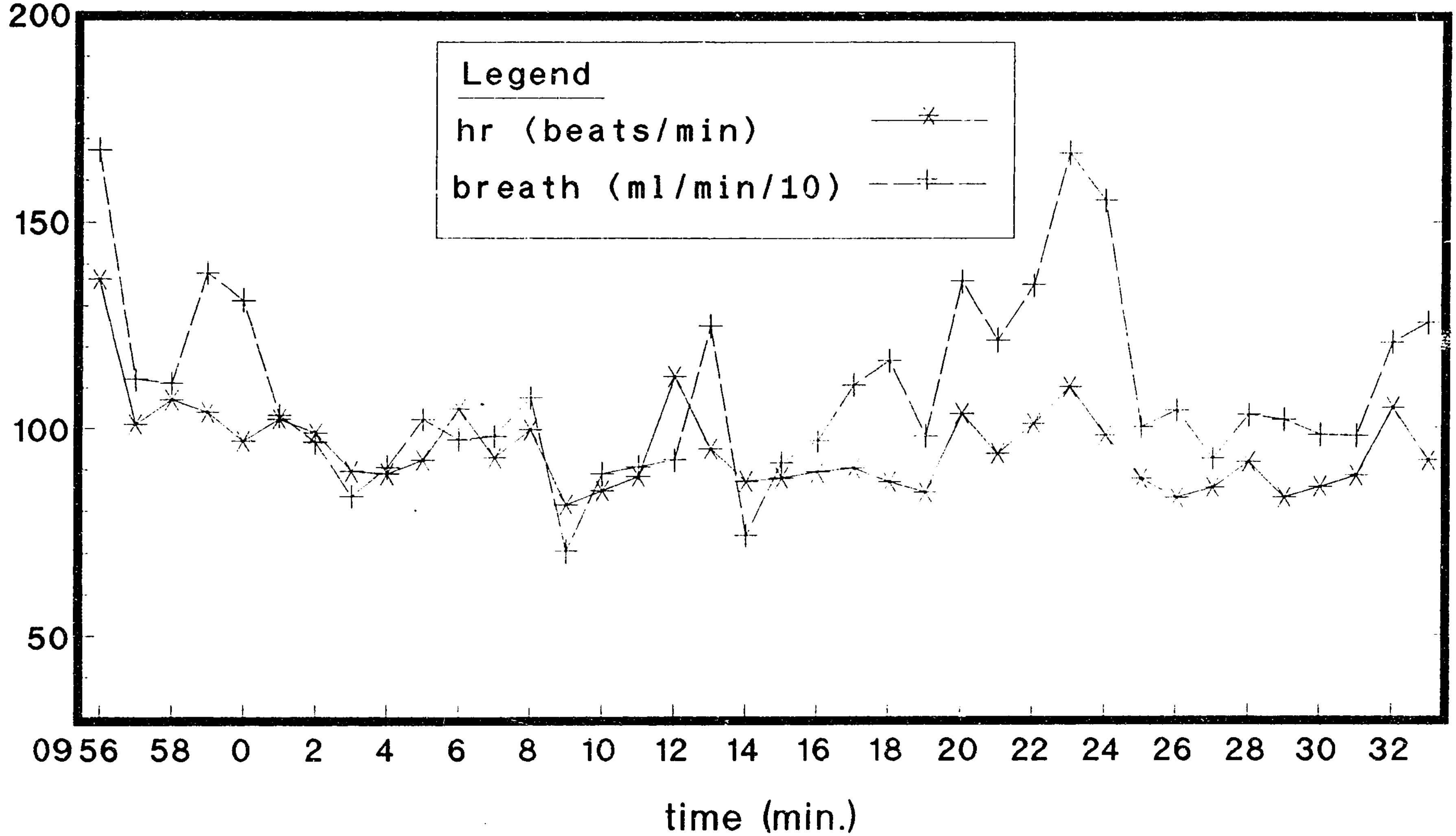
Medical Simula...n 0917- 1013hrs



Written Examination: 1117hrs- 1149hrs

(Figure 14 ; Appendix D)

Subject C demonstrated heart rates which ranged from 66.0 to 78.9. The average heart rate was 70.4 with a standard deviation of 2.3. As indicated by the range, average and standard deviation, the heart rate was fairly consistent through out the written examination. The maximum heart rate demonstrated, occurred at 1117 hrs as the bell signaling the start of the exam rang, and, the subject proceeded to the examination room.

For the majority of the written examination changes in heart rate were again paralleled by respiratory modifications. An instance where the pattern was not followed started at 1140 hrs. Rates remained constant for the span of time from 1139 hrs to 1141 hrs. At 1139 hrs the average tidal volume was 669.3. At 1140 hrs the average volume was 858.3 with 1141 hrs demonstrating a drop to 719.3. The range of the volumes of air exchanged was 638.6 and 984.4. The two volumes occurred two minutes apart. The maximum at 1132 hrs and the minimum at 1133 hrs. There was also a rapid increase in the volume exchanged from from 1130 hrs to 1132 hrs which corresponded to the time the subject asked a question. The average volume for the examination was 755.4 with a standard deviation of 75.2.

During the written examination there was definite sinuous breathing as well as a pattern not evident in the other two subjects. There were periods of low volume breaths followed by a deep inhalation. The sinuous pattern was also different. Peaks of the wave were sharper. There were gradual increases followed by large inhalations, then the pattern was repeated. Also the larger breaths were usually of longer duration.

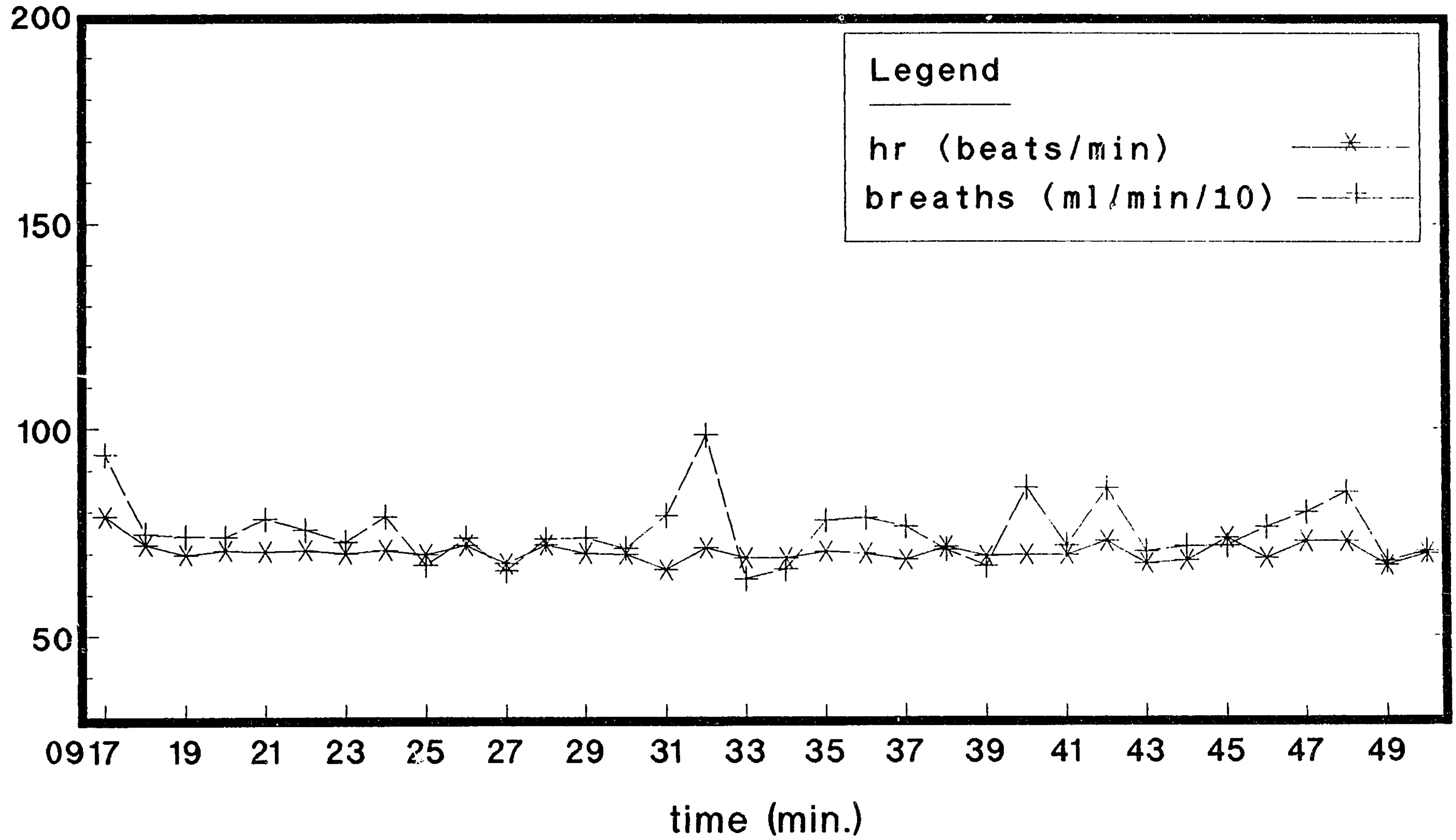
There were 45 paradoxical events during the entire examination. The volume of the events were low and time between each event was fairly constant except from 1144 hrs to 1152 hrs when the proximity of the events were closer.

Oral Examination: 1341hrs- 1407hrs

(Figure 15 ; Appendix D)

Heart rates for the oral examination ranged from 791. to 113.0. The average heart rate was 91.9 and demonstrated a standard deviation of 7.1. The maximum heart rate

Subject C (fig 14)
Written Examination 1117– 1149hrs

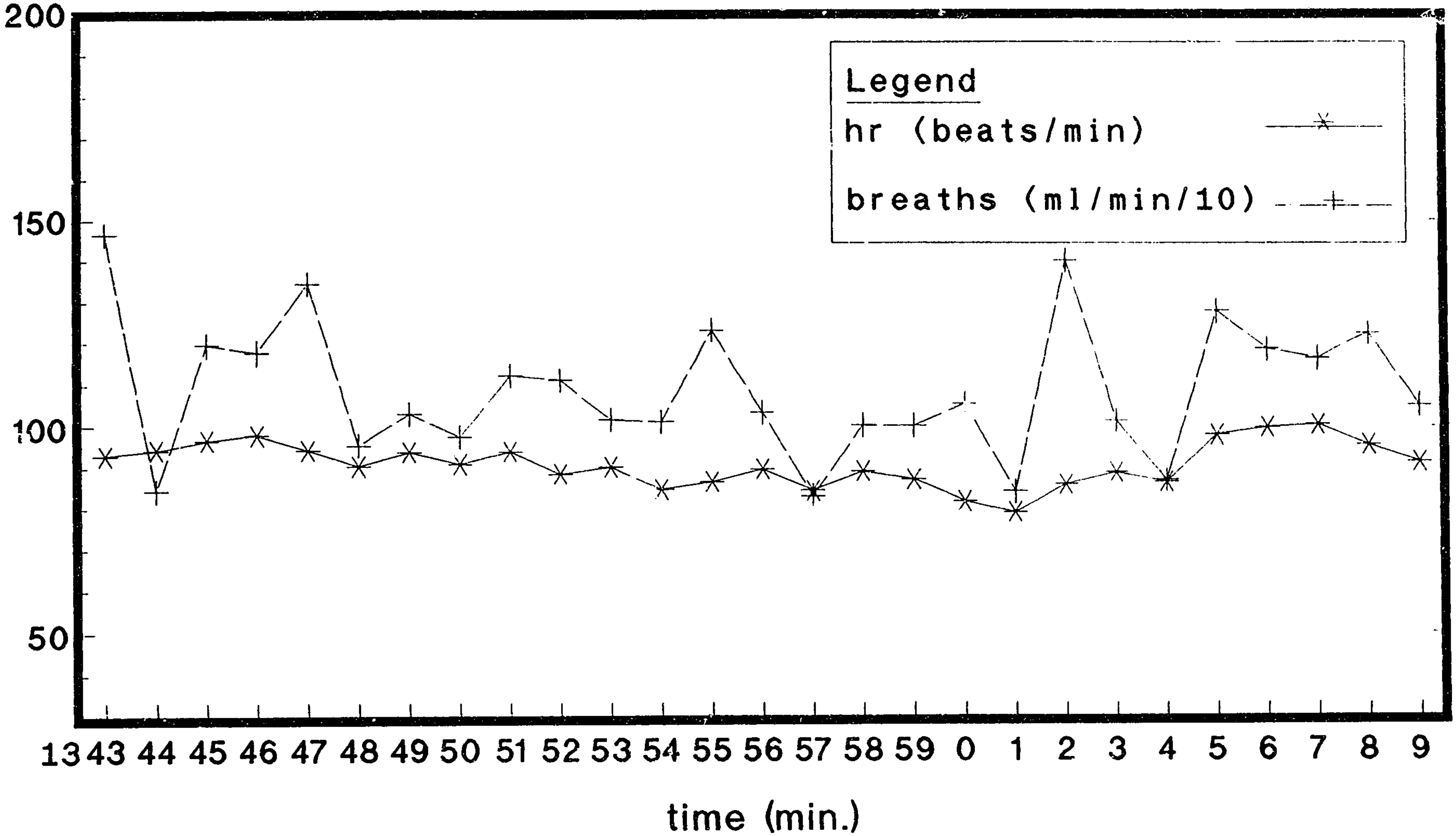


occurred at 1342 hrs. The following minute there was a sharp decrease to 93.0. Heart rates gradually increased over the next four minutes to a rate of 98.0. Following the gradual increase there was a general trend towards a decrease in heart rate. The general trend however, was characterized by increases followed by decreases every minute. A decrease in heart rate occurred at 1358 hrs which lasted for four minutes and reached a low of 79.1. Increases in heart rate remained at the the norm from 1401 hrs to 1407 hrs, at which point the oral examination ended. A heart rate of 100.5 was attained by 1407 hrs and decreased to 91.5 within two minutes after the oral examination was completed.

As with the other situations the subject exposed to, respiratory volume changes paralleled changes in heart rate. The range of the exchange volumes was 830.7 to 1558.8. The average volume for the oral examination was 1103.5 with a standard deviation of 184.4. A peak volume of 1558.8 occurred at 1342 hrs. Volume decreases to 844.3 transpired over the following two minutes. A sharp increase to 1196.1 characterized 1346 hrs. The average tidal volumes dropped slightly and then increased to 1345.5 at 1347 hrs. Average tidal volumes tended to decrease until 1401 hrs. The decline was irregular. Fluctuations were not as consistent as heart rate changes during the same period. A sharp and large increase in average tidal volumes occurred at 1402 hrs. The average volume went from 841.0 to 1400.0. By 1404 hrs the average tidal volumes dropped to a value of 870.0. An increase to 1277 occurred the next minute. In three minutes, at 1407 hrs, the volume decreased to 1165.6, corresponding to the end of the oral examination.

The number of paradoxical events during the oral examination was 38. The events were of low volume and separated by periods of proper breathing. Large paradoxical events which occurred were associated with large changes in heart rate. Although some sinuous wave forms were evident, no consistent rythmn existed. The tidal volumes fluctuated between large and small breaths with an almost breath-by-breath regularity until the end of the oral examination.

Subject C (fig 15)
Oral Examination 1341– 1407hrs



Control vs Medical Simulation

The average heart rate for the control period was 73.8. The range was 62.3 to 98.5 and the standard deviation was 7.7. For the medical simulation the average heart rate was 104.9 and a standard deviation of 12.5 within a range of 75.5 to 142.3. Most obviously, the heart rate during the medical simulation was more erratic than those elicited during the control session. There were more instances of accelerations and decelerations during the medical simulation compared to the linearity displayed during the control situation. As well, the overall rate during the medical simulation was greater than the rate during the control session.

Respiratory parameters displayed comparisons similar to the heart rate in both situations. The respiratory volumes evident during the medical simulation were erradict compared to the control session. Even though the control period demonstrated two distinct breathing patterns, both patterns were very regular. An added similarity existed between the portion of the control session which consisted of deep breaths and the medical simulation; there were periodic deep inhalations. The deep inhalations were more regular and distinct during the control scenario. After a disturbance in the breathing pattern halfway through the relaxation session the periodic deep breaths were replaced with breaths of a substanially lower volumes for the remainder of the control period. There was no evidence of a similar occurence during the medical simulation. There was also an indication of a sinuous pattern during the medical simulation which did not exist during the control session. However, the pattern was not consistent in amplitude or frequency of breaths.

The control simulation did not display any paradoxical breathing events except during the disturbance, and, at the beginning and the end when the subject was moving to and from the location where he was relaxing. Conversely, the medical simulation displayed low volume paradoxical events interspersed with periods of proper breathing for the entire duration. A similarity between the two events was that changes in heart rate corresponded to a change in the magnitude of paradoxical events.

Control vs Written Examination

The average heart rate for the control session was 73.8 with a standard deviation of 7.7 within a range of 62.3 to 98.5. Measurements for the written examination had an average of 70.4 and a standard deviation of 2.3. Interestingly, the written examination displayed an average heart rate which was lower than the control session. However, the average heart rate during the first eight minutes of control session was lower than the average heart rate displayed in the written examination. Average heart rate after the breathing disturbance during the control session were higher than the rate for the written examination. Although the average and standard deviation were lower during the written examination, the control session showed a more linear pattern. The written exam elicited responses which had sharp fluctuations on a minute-by-minute basis.

Respiratory volumes during the control session had an average of 960.7 with a standard deviation of 460.3. Thge range was 395.0 to 1833.3. Corresponding values for the written examination were 755.4 for an average, a standard deviation of 75.2 and a range of 638.6 to 984.4.

Aside from the interruption in breathing during the control session the average volume of the air exchanged was fairly regular in that there were few minute-by-minute fluctuations. The respiratory volumes during the written exam changed quite differently. There were large discrepencies in volumes exchanged almost every minute. Volumes of air exchanged during the first eight minutes of the relaxation session were consistently larger than any volumes displayed in the written exam. In contrast, the volumes during the second portion of the relaxation period were shallower than the volumes in the written exam.

A similar pattern of breathing occurred between the first part of the relaxation session and the written exam. There were periodic deep inhalations. Although the relaxation phase demonstrated deep breaths there were still larger periodic inhalations. In contrast, the written examination consisted of shallow breaths followed by deep sighs. However, the second portion of the relaxation phase demonstrated low volume breaths with no deep sighs.

Paradoxical breathing events were more frequent during the written examination than in the relaxation session. Other than the major disburbance during the relaxation phase there were no paradoxical breathing events. Throughout the written examination there was a deep breath associated with every paradoxical event, but, the converse relationship did not exist.

Control vs Oral Examination

Heart rate measurements varied greatly between the two scenerios. The average heart rate for the control situation was 73.8 with a standard deviation of 7.7 and a range of 62.3 to 80.9. Analogous measurements for the oral examination were 91.9 for the average, 7.1 for the standard deviation and 79.1 to 113.0 for the range. The heart rate pattern during the relaxation time frame was fairly linear throughout, except for the interuption at 1457 hrs and the increase in heart rate at the end of the session. The oral examination heart rate pattern demonstrated a decreasing trend until 1400 hrs then an increasing trend until the end of the session. Within the decreasing trend there were minute-by-minute increases and decreases in heart rate. The increasing trend in heart rate during the oral examination demonstrated a linear increase until the end of the session, except for a single deviation.

Ventilatory parameters contrasted in both situations as well. The oral examination demonstrated an average ventilatory exchange volume of 1103.5 with a standard deviation of of 184.4 and a range of 830.7 to 1558.7. There were large fluctuations in breathing volumes through out the examination. Measurements during the control session had an average volume of 960.7 and a standard deviation of 460.3. The range within which the volumes occurred was 391.7 to 1833.3. Volumes during the first eight minutes of the relaxation session were higher than the average volumes of the oral examination, and, the remainder of the control demonstrated values much lower.

Large very regular breaths with the occasional deep inhalation characterized the first portion of the control session. Shallow regular breaths were the norm of the second portion of the control session. Neither pattern was evident during the oral exam. Large fluctuating volumes with no consistent rythmn characterized the breathing pattern of the oral examination.

Low volume paradoxical events with periods of proper breathing existed during the oral examination. The control phase demonstrated no paradoxical events until halfway through the session at which time there was one major disturbance.

Medical Simulation vs Written Examination

The written examination and the medical simulation differed substantially in respect to the physiological responses elicted. The average heart rate for the medical simulation was 104.9 with standard deviation of 12.5 and a range of 75.5 to 136.3. Corresponding values for the written examination were 70.4, 2.3 and a range of 66.0 to 78.9. Both situations elicited fluctuations in heart rate throughout the scenerios. Changes during the medical simulation were of a greater magnitude and occurred over a longer period of time, usually 2-3 minutes. The changes that transpired during the written examination were smaller and happened on a minute-by-minute basis. Fluctuations which occurred during the written examination did so above and below a stable linear trend. No such consistency was evident during the medical simulation.

Values for breathing parameters for the medical simulation were 1286.3 for an average, 261.6 for the standard deviation and 705.5 to 1914.7 for the range. Analogous values for the written examination were 755.4 for an average, 75.2 for the standard deviation and 638.6 to 984.4 for the range. Changes in average tidal volumes occurred frequently in both situations and occurred rapidly, ie. within two minutes. A major difference between the changes in each situation was the magnitude. Large volumes of exchange were characteristic of the medical simulation and smaller volumes were characteristic of the written examination. The characteristic pattern of short breaths followed by deep breaths evident in the written exam was difficult to identify in the medical simulation.

Medical Simulation vs Oral Examination

The medical simulation had an average heart rate of 104.9 and a standard deviation of 12.5. The range of values was 75.5 to 136.3. The average heart rate for the oral board examination was 919.9 and the standard deviation 7.1. The values of 79.1 to 113.0 represents the range of heart rates elicited during the oral examination. Changes in heart rate during the medical simulation were of larger value, more irregular and occurred at higher levels than the heart rate changes during the oral examination. The fluctuations which happened throughout the oral board did so on a minute-by-minute basis and followed a slightly decreasing trend over time. A continuous, sharper increase, except for one decreasing deviation, characterized the final seven minutes of the oral examination.

An erratic pattern was characteristic of the respiratory patterns for both situations. The average tidal volume for the medical simulation was 1286.3 with a standard deviation of 261.6 in a range from 705.5 to 1914.7. Corresponding values for the oral board examination were 1103.5 for the average, 184.4 for the standard deviation and 830.7 to 1558.7 for the range. Changes in volume were irregular and large for both situations with the changes in the medical simulation being slightly larger than those in the oral examination. Both situations had abrupt changes occurring over the course of the situation. The alterations which did occur over the course of the medical simulation closely paralleled changes in heart rate. A similar relationship was evident for the oral board, but it was not as evident. Whereas large changes in heart rate were associated large changes in tidal volume during the medical simulation, large changes in volume during the oral board coincided with relatively small changes in heart rate. The oral exam had low volume breaths followed by deeper inhalations, a pattern which was not evident for the majority of the medical simulation.

The incidence and the magnitude of paradoxical events was also greater during the medical than those exhibited in the oral examination. A similarity between large paradoxical events from each situation was that they were associated with large changes in heart rate.

Written Examination vs Oral Board Examination

The average heart rate for the written examination was 70.4, with a standard deviation of 2.3. The range of the rates was 66.0 to 78.9. Analogous values for the oral board were 91.9, 7.1 and 79.1 to 113.0. Although the values expressed during the oral board were higher, the temporal pattern was linear for both situations, with the oral board demonstrating a slight decrease followed by an increase. Heart rates elicited during the written examination fluctuated around a linear pattern. Both situations demonstrated minute-by-minute low magnitude fluctuations in heart rate. Changes in heart rate during the oral board were more consistent in that an increase one minute was immediately followed by decreases of a similar magnitude the next.

Respiratory values for the written exam were slightly less than those exhibited by the oral board. The average tidal volume exchanged during the written exam was 755.4 and a standard deviation of 75.2. The range of values was from 638.6 to 984.4. Corresponding measurements for the oral board were 1103.5 for an average with a standard deviation of 184.4 and a range of 830.7 to 1558.7.

As with the comparison of heart rate between the two situations, the pattern of volume exchanged was similar but the tidal volume during the oral board were slightly larger. Both situations demonstrated sharp and abrupt volume changes with the changes during the written examination occuring over one to two minutes, and, the fluctuations during the oral board occuring over two to three minutes.

The pattern of low volume breaths followed by deep breaths evident during the written examination was less pronounced in the oral examination. There were however, large changes in volume on a breath-by-breath during the oral examination.

Paradoxical events occurred in both situations. They were more frequent and of slightly greater magnitude during the oral board examination than the written examination.

Interview

As a whole the subject found the course stressful. He did not find the content of the course too difficult, but passing the course was important to him. He had been waiting 4 years to get admitted into the program. Subject C perceived the course primarily as a challenge, but admitted there were times when he was threatened by the prospect of not passing.

The subject found the medical phase of the course to be the most stressful because it was one area the subject had no experience in. However, difficulties that the subject experienced were dealt with by studying more and asking fellow SARTechs questions.

The subject reported never feeling overwhelmed or helpless during any part of the course. The subject saw himself as being competent in his ability to deal with the course. As well, the subject felt that there was a good deal of support from his fellow students, when it came to dealing with course difficulties. However, the extent of rapport established between the subject and his fellow students did not extend beyond discussing course problems. Personal problems were sometimes shared with his brother and friends via telephone conversations.

Most of the problems that the subject encountered were internalized. According to the subject, he went over problems in his head and felt anxious about them but then proceded to solve the problems. Subject C perceived himself as a perfectionist and did not like to leave problems unsolved. However, he realized that compromise is inevitable in some cases and accepted it.

As a whole Subject C felt that there was a good deal of support for the individual within the military, but felt restricted when it came to making life changes. He reported there was no control for the individual in terms of being able to move or attend university. The restrictiveness was perceived as being a result of military regulation.

During the course the subject reported that he did not engage in any form of exercise. The subject stated that by the end of the day he felt fairly drained and would just sit back and relax. He would watch television and have a beer. Prior to the course and during time off the subject reported that he engaged in running and weight training. He pusued some martial arts and practised Zen for a short duration. Cognitive coping strategies involved using positive self reinforcement.

Interestingly, the subject stated that he sought out "stress" as a result of the course. He stated that he felt that he should be doing someting if there was an easy day or day off. He would go and play video games and pinball.

The subject also reported that he was not apprehensive about being in the study.

Subject C felt he was not under any external pressures to perform well during the medical simulation. He felt good about the written exam and realized that he had made some mistakes, but was not to concerned about the outcome of the test. Subject C felt good about the oral board and thought he answered one question poorly.

The subject smoked occasionally through out the day.

Sensation Seeking Scale

Subject C had an overall score of 21 which placed him within the 50 percentile of scores collected by Zuckerman (1976). On the individual scales the subject scored 8 on the TAS; 6 on the ES; 3 on the Dis and 4 on the BS scale.

Chapter V

DISCUSSION

A. Subject A

Of the four situations in which the subject participated, the degree of physiological activity was highest in the medical simulation, followed by the oral board exam and the written exam. The control session exhibited the lowest degree of activity. The greater degree of activation during the medical simulation can be attributed in part to the degree of movement which occurred in the simulation. The differences in heart rate and the respiratory parameters on the approach to the "crash site" compared to the similar activity of returning the sled to the equipment room upon completion of the simulation, demonstrate the importance of the role of anticipation in contributing to a stress response. All the measurements were higher for the approach. The discrepancy is consistent with the position that there may be a synergistic effect of stressors (Myrtek & Spital, 1986). The additive effect in Myrtek and Spital (1986) occurred for heart rate measures when the stressor combination was arithmetic and exercise on a bicycle ergometer. Although comparisons in Myrtek and Spital (1986) were intergroup, Subject A's response seemed to support the finding on an individual basis. However the subject indicated after the simulation that he felt his performance was poor and he expected to fail. Since the simulation meant so much to the subject the negative thoughts associated with the cognition of failure should have been a source of stress, thus contributing to elevating the level of the post-rescue activation closer to the pre-rescue levels.

The discrepancy can be explained in part by stimulus specificity. The cognitions associated with the approach are ones of anticipation and were directed towards matters concerned with providing the best possible treatment for the victim. The subject had some practise with simulations, but the extent of his experience was limited. As indicated by Fenz (1976) experience is a crucial component when considering an individual's response to a potentially threatening situation. As the medical simulation progressed and the subject's perceived and actual performance decreased, eg. the subject missed an IV placement twice and did not identify potential hazards. Failure to pass the simulation would result in the trainee failing to pass the course. When questioned about how he felt about the simulation the subject stated he failed. Since the homeostatic balance of the body is regulated by both parasympathetic and sympathetic tone, perhaps passive or negative coping strategies result in greater parasympathetic activity. It has been postulated that sudden death associated with stress and helplessness could be a manifestation of an overwhelming degree of parasympathetic tone (Richter, 1957; Vingerhoets, 1985). The subject did not appear content with his performance and was very quiet and somber. When asked about how he felt about his performance he declined to respond. Since the subject's demeanor was depressive perhaps there was a greater degree of parasympathetic tone resulting in a slightly lower physiological activity. However, during the debriefing the subject was informed he would receive a second chance. At that time there was an elevation in heart rate and breathing volume beyond what was exhibited during the previous two minutes.

In order to fully investigate this proposition studies identifying specific coping strategies, the effects of negatively perceived outcomes, depression and psychophysiological activity have to be conducted.

During the other situations, the written and oral examination, the subject demonstrated elevations in physiological activity even though the physical demands were very close to those of the control session. The written examination was a multiple choice test that covered information the students had received on the treatment of trauma. The elevation in heart rate and tidal volume at the onset of the exam occurred as a result of the subject moving towards the testing room. But as with the medical simulation when the subject performed the same activity, after the exam the heart rate, tidal volume and breathing rate were lower. Values demonstrated during the exam exceeded those of the control session indicated that the situation may have been slightly stressful for the subject, which is consistent with other research indicating that examinations can be stressful (Deffenbacher & Hazaleus, 1985; Galass, Frierson & Sharer, 1981; Holroyd, 1978).

The heart rate oscillated slightly more during the written exam than the control indicating that certain questions on the exam may have been more difficult for the subject than others. When questioned after the exam the subjected stated that some questions were difficult but as a whole he was pleased with the exam. The exact questions on which he had problems were not identified, therefore a concise relationship between heart rate and the specific problem cannot be deduced.

The oral examination elicited heart rate and tidal volume values above those exhibited during the control session and the written examination even though the physical requirements were similar. The only difference in terms of physical exertion was that in the oral exam speech was being utilized as opposed to writing. The respiration rate and the minute ventilation for the oral exam were lower. This coupled with the irregular breathing pattern displayed during the oral can be explained by the fluctuating airflow required to compose sentences.

Controlled breathing is the basis of various forms of relaxation practises The increase in heart rate and tidal volume indicates that the oral situation was more stressful for the subject than the written exam or the control. Since the physical demands for the situations were comparable, the impactfulness of the oral situation on the subject was more psychological. When taken in conjunction with the subjective report, the oral examination was positively "stressful". He felt good about the examination. and has been thought of as the crucial component in controlling other regulatory functions (Morse et al, 1984; Ramma, Ballentine & Hymes, 1979). Regulation of breathing during times of stress is a behavioral approach which has been useful in reducing anxiety. Stanescu et al (1981) reported subjects which practised yoga exhibited lower ventilation volumes, higher end-tidal CO_2, higher tidal volumes and lower breathing frequencies, suggesting that Subject A had a healthful breathing pattern during the oral examination even though he perceived himself understress and demonstrated an elevated heart rate. A decrease in breathing rate corresponding to an increase in heart rate during times of perceived stress would seem to question the efficacy of using only respiration rate as the only ventilatory indicator of stress, especially during an oral presentation.

Response Patterns

The values exhibited by Subject A are slightly different than those reported by Tobin et al (1983) which showed normal subjects having a breathing frequency of 16.0 +/- 2.7; tidal volume of 385 +/- 85 ml; a minute ventilation of 6.02 +/- 1.32 L/min. For the medical simulation the rate was within the values reported by Tobin et al with the tidal volume and minute ventilation volume much greater in Subject A. Similar comparisons existed between the written exam and Tobins et al, but the oral exam and the control demonstrated a lower respiratory rate, higher tidal volume and minute ventilation.

Patterns exhibited during the situations can be compared directly to the pattern exhibited directly to the subjects' in Tobin et al (1983a) with one difference in methodology to take note of; subjects in Tobin et al were supine during the recording. The portion of the elasticized strain gauge beneath the subject may be restricted from expanding thereby recording a lower tidal volume. Subject A on the other hand was moving or sitting eliminating the possibility of restricting the chest and abdominal bands allowing complete movement of the strain gauge. This hypothesis has to be tested further in order to determine the amount of discrepancy in measurement between the two approaches.

Other variables to consider which would account for the discrepancy would be anatomical differences and a training effect. Anatomical differences account for a great deal of variablilty in ventilation volumes (Seaton, Seaton & Leitch, 1989; Guyton, 1983; Peters, 1969). SARTech trainees are involved in vigorous activity and conditioning as part of their training program. Training effects on ventilatory parameters include a decrease in respiration rate, an increase in tidal volume and an increase in minute ventilation (McArdle, Katch & Katch, 1986).

Another difference between the pattern described by Tobin et al (1983a) and Subject A was the degree of paradoxical breathing. Subjects in Tobin et al exhibited predominantly ribcage breathing whereas Subject A exhibited very little.

Hyperventilation is considered a normal reaction to stressful circumstances (Suess et al, 1980; Dudley, 1969). Subject A did respond to the situations with an increase in tidal volume and the responses may have been, as indicated earlier, beyond metabolic requirements. There was no indication that the breathing pattern had the potential to become pathological. Although there were irregular sighs, rapid and deeper breathing the subject did not demonstrate any breathlessness or any other signs of breathing difficulty which would implicate suseptibility to hyperventilation syndrome (Garssen & Rijken, 1986) or other problems (Tobin et al; 1983b).

Heart rates during the situations did increase but the rates were considerably lower than those reported for parachutists (Fenz, 1976) and race car drivers (Schwaberger, 1987) suggesting that the situations were within the coping abilites of the individual.

B. Subject B

The medical simulation elicited the highest level of heart rate activity, tidal volume, and minute ventilation. Values for the oral examination were lower except for the respiration rate which was higher. Following the oral examination, in ability to increase arousability was the written examination. The situation elicited a lower tidal volume and minute ventilation than the control session but the heart rate and respiration rate were higher.

The situation for Subject B was similar and different than for Subject A. It was similar in that doing well was also very important for Subject B. He had sacrificed his position and received a decrease in pay in order to become a SARTech. A well established support system with a fulfledged SARTech and frequent phone calls to his family supplemented the knowledge the subject had about teaching practises in the military. If all taken together Subject B had a well established support system.

It differed because Subject A was a buddy and Subject B was a leader. By being a buddy during the medical simulation the pressure of making decisions about the victim's treatment was absolved. However, his performance indirectly effected the performance of his partner who was in a predicament similar to Subject A. Subject B did indicate that he was not anxious about the medical simulation and felt it went well. Again since the subject was moving it was difficult to deduce how much of the elevated heart rate and breathing parameters was due to an increase in metabolic need and how much was a result of psychological factors.

As the rescue operation commenced the subject demonstrated an increase in heart rate from 99.7 to 121.0 and an increase in tidal volume up to 1490.0 from 1007.9. The breathing rate increased by 2 breaths per min up to 14 and the ventilation volumes climbed from 12.1 to 20.86.

The following minute the ventilation volumes continued to climb but the heart rate decreased.

Upon completion of the medical simulation as the subject was aiding in returning the gear to the equipment a much lower heart rate was evident. The heart rate was 73.5. The breathing parameters were around the mean of the scenario. The tidal volume was 1446.2 ml., the respiration rate remained at 14 and the ventilation volume was 20.24 L/ min. Using heart rate as the only indicator of the metabolic activity, one could assume that the elevation in heart rate prior to the onset of the simulation would implicate pre-simulation anxiety. Respiration rate remained the same, and tidal volume increased suggesting that perhaps regulation of breathing was being implemented since deep breathing at a controlled rate has been used for controlling pre-competive anxiety and in various other behavioral interventions for regulating anxiety (Feuerstein et al, 1986). The subject did not report the use of any form of coping strategy during any of the situations. Also the recovery time to mean values for the respiratory parameters, during the onset of the simulation, required four minutes whereas the heart rate returned to mean values in two minutes again suggesting the possibility of higher cortical influences on breathing.

The control period for the approach, the time when the subject was returning the sled to the equipment room, demonstrated a heart rate which was substanially lower than the mean for the medical simulation. Taken in conjunction with the previous information on the pre-simulation condition and the medical simulation as a whole, heart rate readings would seem to indicate concern on the subject's part, about the medical simulation. Perhaps as suggested by Fiske and Maddi (1969) Subject B requires a higher level of activation. This would seem to be indicated by the score on the Sensation Seeking Scale even though the rating is not unusually high (Zuckerman, 1976).

Low values for the physiological measures were characteristic of the written exam. The values were close to the mean of the control session with a shallower tidal volume occurring during the written examination. Minute ventilation was lower during the written test as well because the rate was similar to the rate during the control session. Since minute ventilation is a product of breathing rate and tidal volume the lower tidal volume contributed to the decrease. The control session was cut short just as the subject started to show consistently lower values. Had the session proceeded the entire twenty minutes the values would probably have stabilized (Linden & McEachern, 1985) resulting in a lower mean for the control.

Values for the oral board were not much different from the values of the written examination. The breathing frequency and tidal volume were slightly higher contributing to the elevation in the minute ventilation. Speech scenerios have been shown to be a reliable stressor(Dimberg, Fredrickson & Lundquist, 1986; Jones, 1986). This coupled with the evalutive aspect of the oral board an increase in psychobiological activation should have resulted. Two likely reasons for it not increasing could be: 1) The subject revealed during the interview that he felt comfortable with his knowledge and he was ready for the oral board; 2) he had previous experiences in public speaking as an instructor for the military. This combination of experience and the positive attitude the subject had about his abilities was probably a contibuting factor in the low values (Fenz, 1975)

However, it can be argued if as mentioned earlier, the individual required a higher level of psychobiological activation, the values should have been higher. Two reasons can be given which would explain the lower values and still remain consistent with the aforementioned position. Firstly, the subject indicated during the interview he wasn't too concerned about either the written exam or the oral examination, which would explain a lower level of activation. Secondly, the medical simulation and practical aspects of the course appealed to the subject, and, he enjoyed doing medical simulations. According to Czisentmalhalyi (1975) many experiences are positive and result in levels of psychobiological activation similar to negative experiences. A similar position was postulated by Selye (1976) when he coined the terms "eustress" and "distress". The summation of the previous position is that the subject found the medical simulation challenging and he was waiting in positive anticipation. The written and oral scenerios on the other hand were not of major concern to the subject. Those cognitions associated with the subject's previous experiences would explain the lower values exhibited during those two circumstances.

That the oral examination exhibited slightly greater values could be interpreted as an indication the oral examination was marginally more anxiety provoking than the written examination.

Response Patterns

The most obvious repeating pattern during a large portion of the day and during the three situations was the large degree and extent of paradoxical breathing. With the onset of any situation the subject's paradoxical breathing increased. The most vivid example was during the medical simulation followed by the written examination and then the oral board.

Chest breathing has been identified as one of the characteristics of hyperventilation syndrome (Garssen & Rijken, 1986) and implicated as being an unhealthy manner of breathing, which could assist in the development of a number of chronic pathological conditions (Rama, Ballentine & Hymes, 1979). According to Tobin et al (1983a) an unusually high number of normal subjects exhibited predominately thoracic breathing. The respiratory values for the subject are high except for the rate when compared to the normals in Tobin et al. A breathing pattern similar to Subject B was demonstrated by symptomatic asthmatics (Tobin et al, 1983b). They had a normal frequency, an elevated tidal volume and an elevated minute ventilation with a larger degree of paradoxical breathing.

During the relaxation session and at various times throughout the day the subject demonstrated much less paradoxical breathing, a lower respiration frequency and a lower tidal volume suggesting the subject may be predisposed to acquiring an asthmatic breathing pattern if a large number of stressors were evident in his life and if appropriate coping methods were not applied. The etiology of asthma is an unresolved issue because of the number of variables associated with the disease (Seaton, Seaton & Leitch, 1989).

Due to the methodological differences which existed between the current study and Tobin et al (1983b) the discrepancy in volumes maybe irrelevant. Also that the subject demonstrated the ability to relax and reduce all aspects of physiological activity was an indication that he was capable of controlling his degree of activation. Considering the subject's positive disposition and well established support system there is little indication the pattern would become pathological. But as mentioned by Whatmore and Kohli (1974) many disorders may be a manifestation of patterns, consolidated by misdirected effort, beyond an individual's awareness.

C. Subject C

As with the other subjects, Subject C demonstrated the most intense physiological reaction to the medical simulation, when compared to the control session, as demonstrated by all the variables, respiration rate being the exception.

Again, the increase in physical activity associated with the medical simulation would be the major reason. Performance or evaluative anxiety would not be a very important variable because he was not the leader of the group, and, he had previously passed the medical simulation. However, as was the case with Subject B, Subject C's role would have an indirect effect on his partner's performance; possibly contributing slightly to the stress of the situation for Subject C.

That there is an additive effect of stressors on physiological activity has been demonstrated in football refrees (Conti & Melintock, 1983; Holland & Cherry, 1977), basketball refrees (Holland, 1979; Porter & Allse, 1978) and in laboratory situations (Myrtek & Spital, 1983). Differences in responses during the approach to the crash site (0924 hrs) and upon completion of the simulation (1032 hrs) for activities requiring the same level of the exertion, indicated the synergistic effect of psychological factors, and, perhaps the effect of anticipation on elevating physiological systems beyond situational metabolic requirements.

Another interesting point during the medical simulation that warrants discussion was the sharp increase in heart rate upto 142.3 with increases in tidal volume upto 1914.7 and minute ventilation to 45.9. These changes corresponded to the time the victim was being transferred by the subject and his partner from the crash site to the stretcher. That all parameters increased was an indication of the degree of exertion required on the part of the subject to perform the manouvre. The degree of response was not too suprising considering the subject was a smoker. The inefficiency of the subject's lungs in fulfilling the metabolic requirements can be deduced by comparing the first part of the medical simulation, during which time there is a large degree of movement, to the second half of the simulation where the victim was in the stretcher. The respiratory parameters did not deviate as greatly from the heart rate during the second half of the simulation when compared to the first half. Further evidence supporting the claim can be demonstrated by looking at the relationship between the tidal volume and heart rate at the time when the subject was carrying the sled back to the equipment room (1032 hrs) The tidal volume increased more relative to the heart rate during a transition from a time of little activity, putting gear on the sled, to a period of greater physical exertion; when the sled was being transported to the equipment room.

The medical simulation as a whole was not psychologically stressful for the individual as indicated by the post-simulation interview. But the effects of smoking made the situation appear to be stressful to the respiratory and cardiovascular systems.

When little exertion was required the two systems were more compatible as demonstrated by the written examination. The mean heart rate and tidal volume was lower whereas the respiration rate was higher when it was compared the control session. The higher respiration rate contributed to a higher minute ventilation. From the comparison it appeared that the baseline period was the more stressful experience. Data accumulated throughout the day suggested the subject was most comfortable with, or, had established a breathing pattern which, had resulted in low volume and rapid breaths. However, prior to the control session the the subject was informed to focus on diaphragmatic breathing. It appeared that the subject did engage in that type of breathing initially and then some event, most likely a cough, caused the individual to revert back to his normal pattern of breathing. The occurrence would seem to contradict findings in other research advocting the use of breathing exercises to aid in alleviating some problems associated with respiratory ailments (Stanescu et al, 1981; McCaul, Solomon & Holmes, 1979). Although the controlled breathing practise engaged in by the subject was in itself a source of stress, it was probably excessive for the individual. Appropriate guidance would have resulted in establishing an adequate level of breathing for the individual.

The oral examination was another source of potential stress. During the interview the subject expressed a slight degree of doubt about his performance on the exam. The perception and the increase in physiological activation support the contention that the situation was mildly stressful. There was a slight increase in heart rate when he discovered he was the first to go. The heart rate and respiration rate climbed over the next minute as the subject went to the room. The rates remained elevated for approximately one minute and began to decline. They did remain however, above values exhibited before the oral examination commensed. After the exam the subject indicated he felt his performance was fairly good and he realized he had responded erroneously to a couple of questions, but he was not too concerned about them.

Response Patterns

The meaning of the values exhibited by the subject are difficult to assess due to the fact that the individual smoked. Smokers in Tobin et al (1983b) exhibited respiratory patterns with a slight increase in frequency and moderate increases in tidal volume, both contributing to increases in minute ventilation. Compared to the values of the normals in the Tobin et al study, the baseline for Subject C demonstrated a lower breathing frequency, a higher tidal volume and higher minute ventilation. The resting heart rate for the subject was average (Guyton, 1981). The values of Subject C indicate a relatively "normal" level of basal excitation. The responses to the situations created some repeating changes which were not evident in the control. The control demonstrated a linear pattern of breathing even though the volumes varied quite substantially, as was discussed earlier. Periodic sighs and an oscillating or sinusoidal pattern repeated itself throughout the day and during the various situations. Shallow respirations followed by a sigh have been identified as characterizing Hyperventilation Syndrome (Garssen & Rijiken, 1986; Grossman, 1983), a sign associated with chronic anxiety (Tobin et al, 1983b).

The elevation in parameters in the baseline session, above what is considered normal, could be a result of the effects of nicotine on peripheral and respiratory center receptors (Silvetta, 1962). This is a viable consideration because the subject did smoke during the day. In support of this conslusion Gilbert et al (1989) demonstrated the agonistic nature of nicotine's anxiolytic effect; an effect hypothesized to be mediated by the right hemisphere.

Aside from the acute effects Tobin et al (1983b) suggest that the chronic effects of nicotine in the body result in "... a higher respiratory set point induced by chronic intermittent stimulation with nicotine..." (p. 290). It is difficult to determine how much of the chronic effect is due to the changes caused in the lung structure resulting in a need for increased respiratory drive, and how much is due to direct effects on the respiratory center.

The responsiveness of the systems measured could also be explained in part by Fiske and Maddi's Consistency Model of personality (1968) which suggests that individuals strive to attain a level of homeostatic activation with which they are comfortable. The theory indicates that the level is a result of the individual's genetic pre-disposition and experiences. The efficacy of the position is somewhat substantiated by a comment made by Subject C regarding how the course as a whole had effected him. He stated that he felt he needed more excitement in his life as a result of the course. Video games became the source of excitement for the individual. Even though the Sensation Seeking Scale (Zuckerman, 1976) has a slight correlation with physiological activation, and, it measures the degree to which an individual needs novelty and excitement, Subject C's score was in the 50 th percentile, indicating the subject was about normal in his desire to experience new sensations. The development of a homeostatic level is dynamic (Fiske & Maddi, 1968) and there is no indication of how stable it is and how long a new level takes to develop. Perhaps Subject C was in the process of developing a new level. That levels change is supported in part by work done on personality differences. Norton (1989) identified different personalities based on their outlook on life, either positive or negative, and the exuberance exhibited by the individuals when they spoke about their life metaphors. Future studies identifying the different personalities and physiological monitoring have to be conducted in order to assess if a relationship does indeed exist.

The response patterns exhibited by Subject C are indicative of respiratory insufficiency and hyperreactivity. A large part of the problem in determining the impact of psychological variables on the pattens is because the individual smokes. Other factors in his life indicate he has a good support system, his brother, and has good rapport with his fellow trainees. The subject was active and had engaged in different activities ranging from Zen meditation to a weight training regime. Based on comments made during the course of the day and when questioned after each situation there was an indication that the subject had a positive disposition.

The subject also perceived himself as a perfectionist but stated he was willing to compromise. Problems were solved by the subject by thinking about them until he came up with a solution, indicating perhaps that he may be inclined to be a repressive individual; a personality trait which has been associated with hypertension. One aspect of military life he found frustrating was that it prevented individuals from having the freedom to make life choices because you had to go where the military dictated for you to go.

Chapter VI

SUMMARY AND CONCLUSIONS

The intent of the study was to determine if individual physiological response patterns are repeated during different environments that may have the potential to be stressful. As well, it was hoped that characteristics of a particular pattern might identify whether or not an individual was demonstrating a pattern during the situatuions which might implicate the eventual manifestation of a pathological condition. The systems monitored were the respiratory and cardiovascular systems. In addition to the physiological responses phenomenological perspectives and coping strategies were identified in order to provide a more comprehensive picture of how the situations the subjects were in may have differed for each individual.

A modified case study design allowed for the continuous monitoring for an entire day in which there were three real life testing situations. The subjects were military personel called SARTechs, who were in training. A baseline was established from which comparisons of physiological data were made. All situations did result in some degree of elevation in some if not all of the parameters measured. The idiosyncrasies of the responses emerged when it was scrutinized as to what parameters changed and the magnitude of the change.

Of the three subjects, Subject A demonstrated the healthiest breathing pattern, but his psychological reaction was suggestive of a depressive response, a personality implicated in the onset of disease (Siegel, 1989).

Subject B on the other hand exihibited a potentially unhealthy breathing pattern which was dominated by paradoxical breathing. Psychologically the individual had a very positive disposition. His experiences contributed to making the situations subjectively less threatening, and, a well established support system was also evident for the subject. The combination of the above factors suggest a healthy environment for the subject (Feuerstein et al, 1986). Modifying his breathing pattern would probably increase the individual's health. (Rama, Ballentine & Hymes, 1979)

Subject C was a smoker and exhibited responses that appeared to be more sensitive to metabolic requirements. However, the synergistic effects of psychological stress was evident. The subject did demonstrate a pattern of breathing which had the potential to become health threatening . Coping strategies and perceptions of himself suggest a disposition which is fairly healthy.

Although the report is descriptive and suggestive, the inferences arrived at are based upon research on different populations in a variety of controlled laboratory settings. Life is a process requiring constant change, and, it is difficult to predict future occurences on just one day. Although consistency in responding over a longer period of time (Manuck & Garland, 1980) it would be an astronomically large task to identify exactly what pattern of both physiological and psychological factors would lead an individual from a state of health to a state of disease when only considering a short, and for all intents and purposes, static period of time.

Recommendations

The forth coming recommendations will be presented in two parts. The first part will be methodological and suggest changes which should be made in future research directed at interpreting an individual's wholistic response to change. The second part will address philosophical considerations focussing on the need to break away from the traditional practise of reductionism in scientific research and begin to integrate knowledge from different levels of the human person to begin to understand how change in the external environment results in change in the internal milieu leading to health or disease.

The enormity of the task of monitoring changes in an individual can be appreciated by trying to verbalize what is happening in an event as common as walking. Modern technology has allowed researchers to freeze time, making analysis of behavior at different levels less combersome. In order to acquire a more comprehensive and complete picture of what happens when change occurs a team or a group of people would be needed to perform the the multiple functions required for the different aspects individual behavior to be measured. One person should produce a video recording with an on-screen clock to help keep an accurate record of the environmental and behavioral events which occur. This would produce a permanent record of the events in a form which could be refered to whenever needed. All the recording equipment should be synchronized in order to allow for congruent matching of environmental, behavioral, physiological and psychological events.

By having one person responsible for one or two variables a multidimensional description of the relationships between the parameters at a specific time and over time would be possible.

Phenomenological data should be collected before, during and after an event to help assess whether or not the experiment of experience resulted in any pilosophical changes thereby allowing the collection of information on coping strategies, and, whether or not the experience had any effect on the subjects. A concise as possible measurement should be done on the physiological system of interest. New developments in technology allow minute- by- minute recording of systems such as heart rate, cardiac waves and respiratory parameters. In those systems where continuous monitoring is not possible, ie. hormonal responses, the shortest timeframe around an event should be used. At the very least a pre and post event measurement should be taken as well as one during the establishment of a baseline. Since a body is a finite universe, and, events which happen in one system influences others; systems ancillary to the one of interest should also be considered, allowing for the process resulting from the interaction of the organism and the environment to be traced.

Careful consideration of the variables involved and a clear picture of what the overall goal is, is a necessity in coordinatting a research team. Once the problem has been identified by the primary researcher, others involved in the study should be included in the development of the methodology to ensure they understand how their role contributes to the final outcome.

Homeostasis is a result of the various input along two lines of communication; the sympathetic and parasympathetic chains of the autonomic nervous system, which is influenced by input from the central nerous system and the limbic system. In examining the individual and environmental interaction the effects of the communication between all three systems have to be considered. Stress research has been guilty of focussing almost exclusively on sympathetic activity, which is justifiable providing it is the sympathetic nervous system alone being activated.

In 1977 Libchaber and Maurer, were fortunate enough to design and conduct an experiment which allowed them to monitor the absolute beginnings of turbulent flow (Glieck, 1987).*Tabla rasa*. As much as psychologists and physiologists would like to recreate the condition of starting with a "blank slate" within a person, it is a task presently beyond current technology. Therefore it is necessary to establish a phenomenological congruency between the researcher and the subject. Hence the need to pay tribute to the effects of the central nervous system and the limbic system and their repercussions on the internal environment. Ultimately it is the interaction and degree of tone between the four systems which provides the static picture of what is occurring at particular instant. By adding the temporal component of feedback a whole new set of input is provided causing a further change. Factors contributing to a fight or flight response result in a modification in the degree of parasympathetic and sympathetic tone leading to humoral and physiological changes which provide feedback to the central and autonomic systems. The central nervous system and the limbic system interpret some of the information and provides yet another source of data which changes the original input to create a whole new set of variables.

Spielberger (1966) postulated that two types of anxiety, state and trait existed. Neither is significantly predictive of physiological or psychological responses to potentially threatening stimuli alone, but in conjuction may provide a more accurate explaination of the interaction between what the individual brings into the situation and what the environment provides.

Living organisms are unique in their ability to adapt as is evident by the changes which occur as a result of exercise and learning. The key to consider is change. It is essential for human wellness. It is consistency which is lethal, or the enduring characteristics of an individual which lead to repetition.

Research to this date has provided hundreds of thousands of "snap shots" of the motion picture called adaptation. It has given future researchers the essentials required to begin to understand and track adaptation. In order to determine if the picture is one of health or illness it has to be watched for its duration. In otherwords, multifaceted, multidimensional, longitudinal studies have to become the future trend in human "stress" research.

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Observational Data

0830

Subject C is walking around reassuring a fellow student.
Subjects A & B are sitting at their desks.

0835

Subject C went to get a coffee and is standing and drinking it.

0844

Subject A is selected as team leader and is in a pass/ fail situation; he is sitting there quietly
A sargent came into the room

0850

Subjects B & C are discussing hockey with the researcher.

0900

All subjects are discussing military life with the researcher; Subject A has been a part of the armed forces for 10 years; Subject B for 9 years; Subject C for 8 years.
The atmosphere is tense
Subject B is talking freely
Subject A is still quiet
Subject C is quieter than previously.

0915

The subjects are telling the researcher how one [illegible]s demoted to corporal when entering SARTech training.

0922

Subjects A and C start their simulation; Subject B start to talk about diving.

0926

Subject B starts his medical simulation; he is briefed about the condition of his victim.

0928

Subject A and C start their rescue procedures; Subject A is the team leader.

0929

Subjects A and C arrive at the crash site and are preparing their gear.

0933

Subject B is preparing an intravenous

0935

Subject A is looking for a needle placement for his victim.

0939

The needle placement for Subject A is incorrect; the vein had been punctured and a new placement has to be sought.
The evaluator is in close proximity to Subject A.

0940

The individual that Subject C is working on regains consciousness; he starts to talk to the victim.
The simulation does not appear to be going well for Subject A and C.

0943

Subject A starts his second attempt at an intravenous. It is not successful and he has to simulate the needle insertion.
The evaluator is leaning over the Subjects' overseeing the procedure.
Subject C is applying MAST pants to his patient.

0947

The victim that Subjects A and C are working on regained consciousness and they administer oxygen. Subject A is talking to the patient.

0949

The patient Subject A and C are aiding starts to hyperventilate; normal breathing is re-established when the dressing over the opened pneumothorax was released.

0951

Subjects A and C are preparing to move the victim from the accident scene to a stretcher.

0953

Subjects A and C are moving their patient.

1000

The victim Subject B is working on becomes alert and verbal.
Subject A is doing an extremity check on his patient; Subject C is preparing to change the intravenous.

1001

Subjects A and C are splinting the patient's arm; the patient is complaining about the treatment he is receiving.

1012

Subject A and C are talking to a "physician"; the simulation did not go well.

1016

Subject B and his partner are preparing to move their patient from the plane wreckage.

1018

The patient is being moved

1022

Subjects A and C are carrying their rescue sled back to the equipment room (control for carrying the sled to the accident site).

1024

Subject B and his partner are preparing to move their patient to complete the operation.

1029

Subject B and his partner are debriefing the "physician'.
Subject A and Subject C are restocking the rescue gear. The atmosphere appears very depressed.
Subject C is relieved the the simulation is over; Subject A is very quiet and looks quite somber.

1035

Subject B feels good about how his simulation went; he states that he likes the simulations more than the lectures. Subject B is talking over procedures with his partner.

1042

Subject B and his partner are carrying the sled back to the preparation room (control for the beginning of the simulation.

1043

Done with the medical simulations

1050

Subject A and C are getting debriefed; the officer is stern but straight forward; the subjects are standing.

1055

Subject A is getting grilled for his performance; he answers the occasional question but on a whole is not talking too much; Subject C is standing quietly to one side.

1058

Some positive feedback is given then more is said about aspects of the simulation that were not performed correctly; Subject C appears to be concerned.

1059

Subject A looks tense.

1100

Debriefing for Subject B and his partner commenses; Subject C is correcting his assessor on some issues.

1101

The debriefing for Subjects A and C has ended; they were told to go outside and relax.

1102

The assessor gave encouragement to Subject A and told him that he would receive a second chance.

1106

The debriefing atmosphere for subject B and his partner is relaxed; Subject B looks relaxed and indifferent; the simulation went well.

1107- 1116

The whole class is sitting in the sun.

1117
The exam bell rings.

1118
The students are told that the exam is twenty pages long (a joke); it should take about twenty minutes to write but they will be given an hour.
They started writing.

1125
Subject B asks a question.

1126
A sargent walked into the room; a trainee asks a question.

1127
Subject C is tapping his finger and appears to be a little nervous.
Subject A appears very intense.
subject B seems to be relaxed.

1130
Subject C asks a question.

1135
Subject B has completed his exam and is going outside.

1138
Subject B is drinking a coffee.

1147
Subject C asks a question as a joke.

1150
The whole group has completed the exam and are sitting outside in the sun discussing the test.

1152
Subject B feels good about how the exam went.
Subject B is still thinking about the exam.

1200- 1246
Lunch. There is a very relaxed attitude and a little bit of discussion about the exam.

1250
Sixteen chin ups.

1300
Reviewing the quiz.

1307
Subject B is discussing a question.

1311
Subject C is told an answer is wrong; he is informed the response to his query was a joke.

1318
The students are asked what they thought of the exam.

1322
They are through discussing the exam; they have to wait for a physician who will be sitting on the oral board.

1338
Subjects A and C are sitting out in the sun.

1341
Subject C finds out he is going first.

1342
The oral board examination starts; The trainees had had a practise session.

1355
Sargent appears in in the doorway and starts to talk to the trainees.

1357
Everyone does 35 push-ups.

1407
Subject C is done with the oral board and is drinking a coffee; he is interviewed by the

researcher.

1447

Subject A goes into the oral board examination.

1450

Subject C is told to sit in an area of his choice away from everyone else and focus on his breathing for twenty minutes.

1507

Subject A completes his oral board and he feels it did not go well; he goes to pick up a check.

1516

Subject C completes his control session.

1535

Subject B goes into the oral board.

1540

Subject A is interviewed and he is given the same instructions as Subject C.

1612

Subject A goes to sit down in a secluded location of his choosing and is told to focus on deep diaphragmatic breathing.

1641

Interviewed Subject B and he was given the same instructions as the previous subjects.

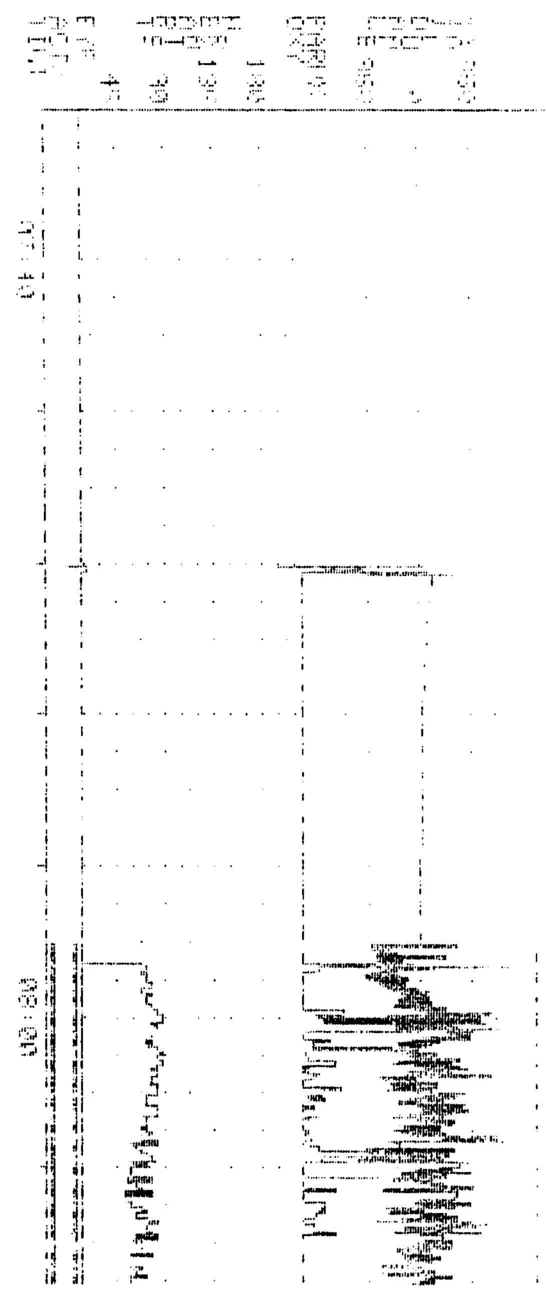
Appendix B

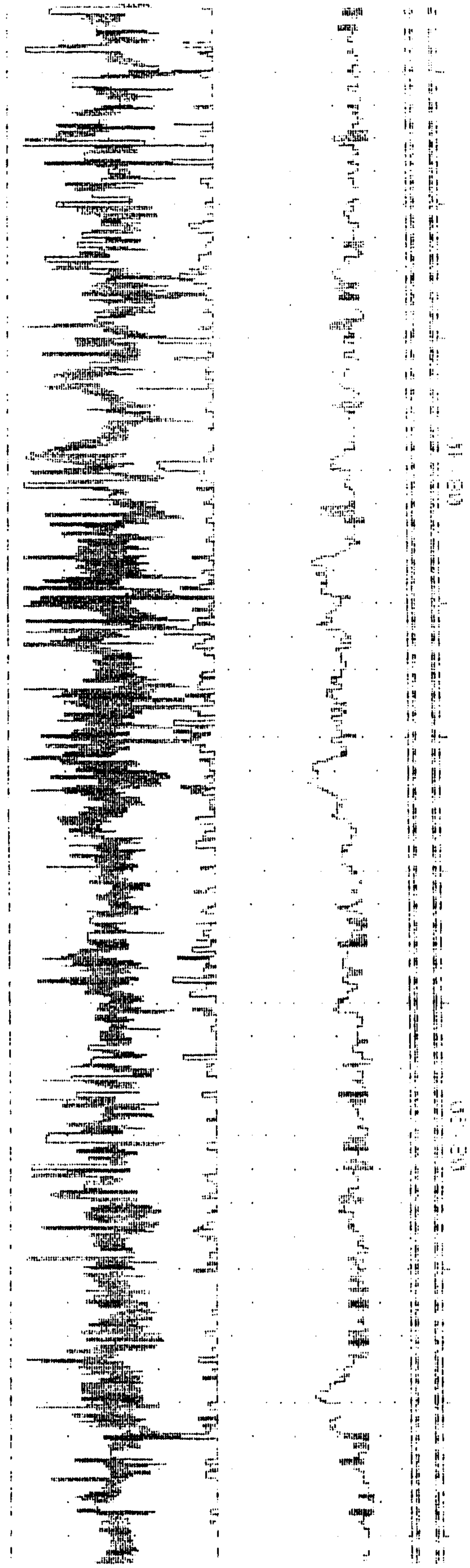
Patient Id :MILITARY

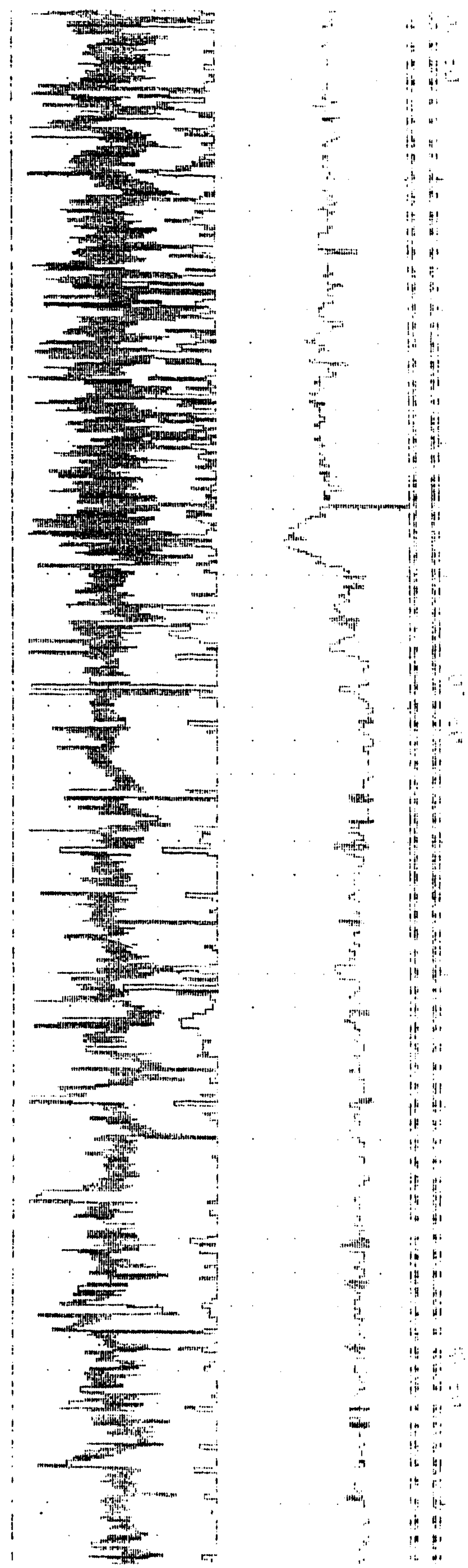
Recording Date : 051589

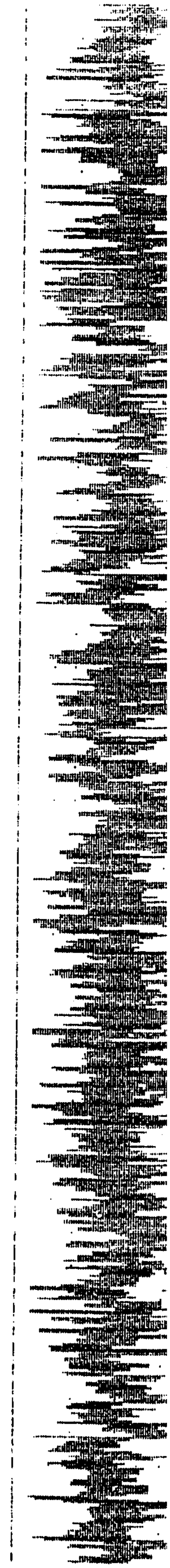
Age : 27

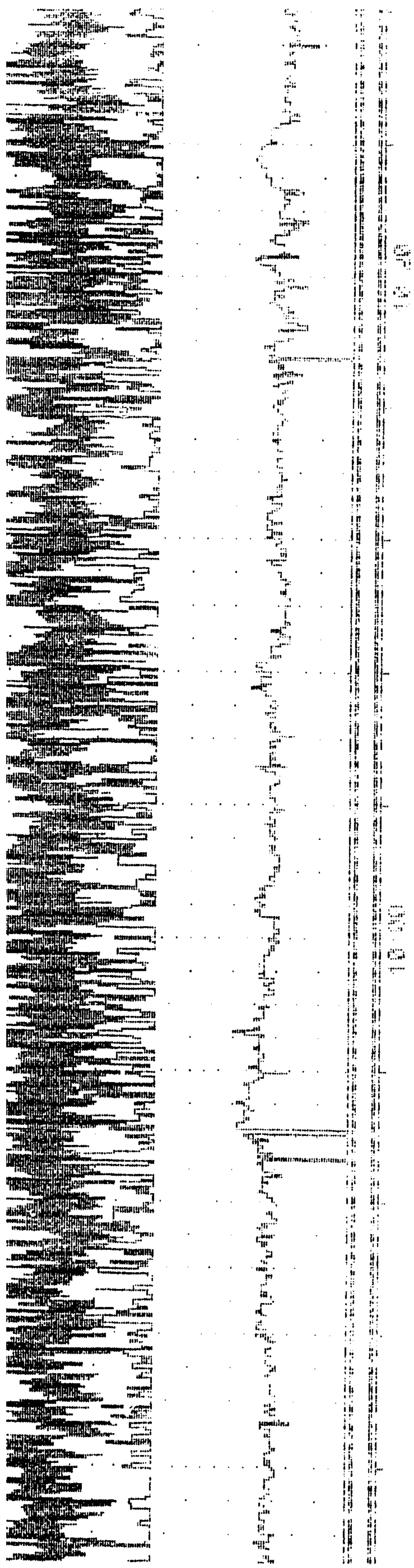
Weight : 160

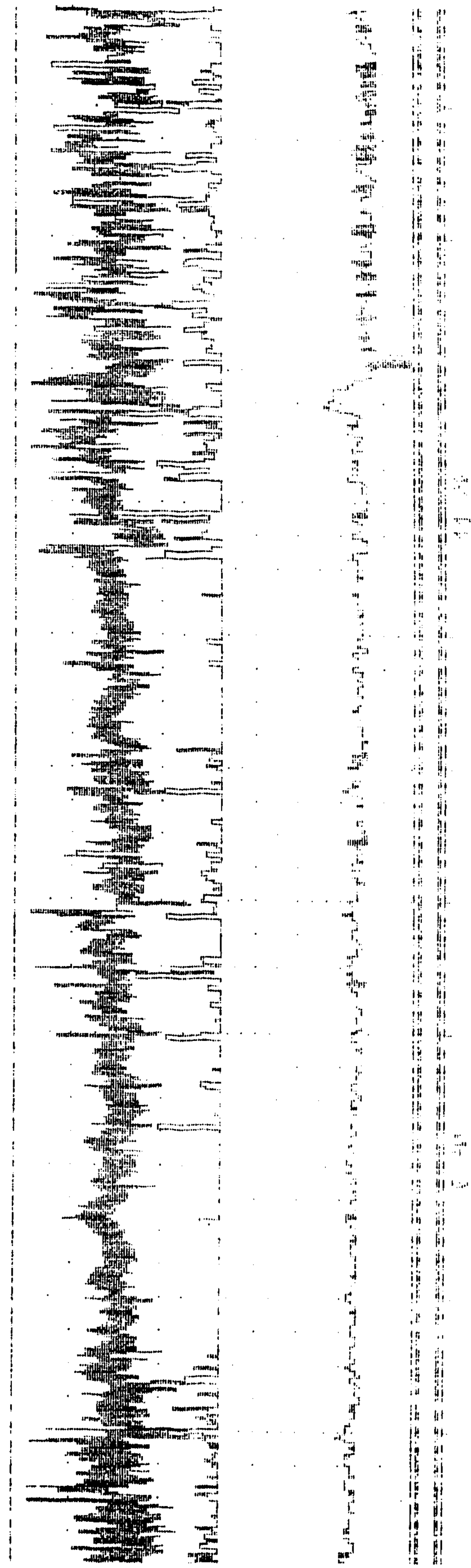


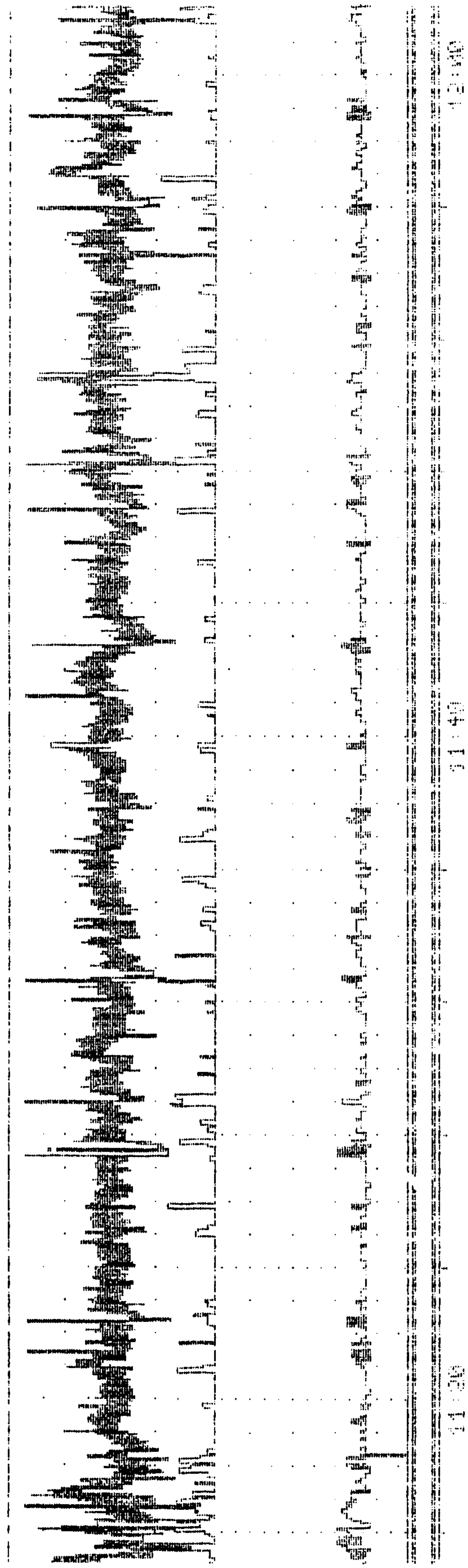


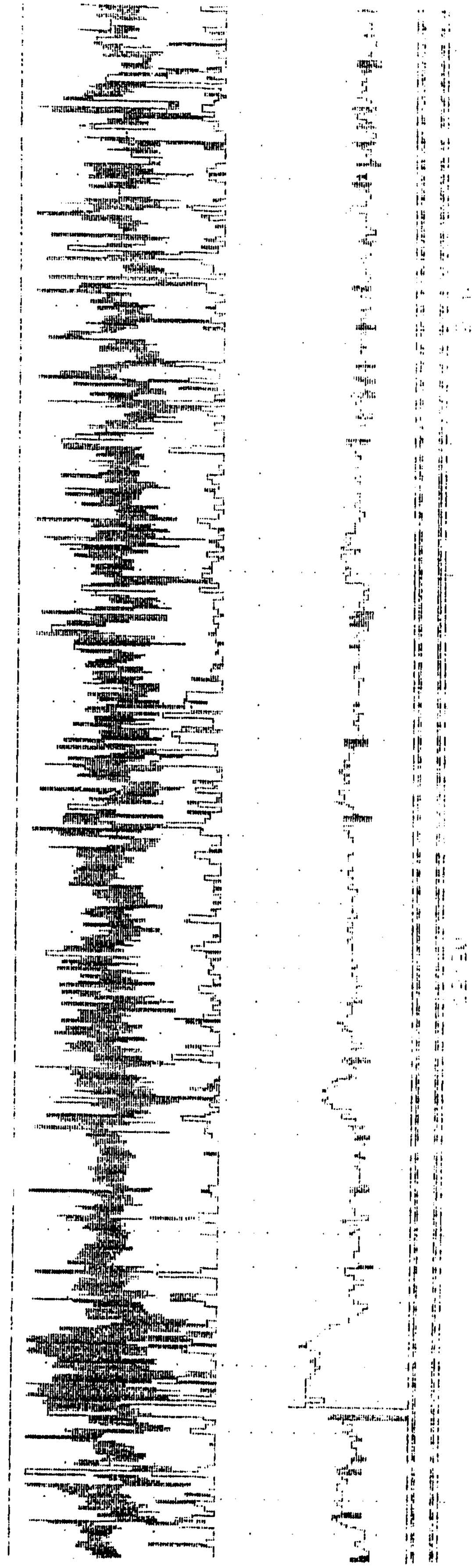


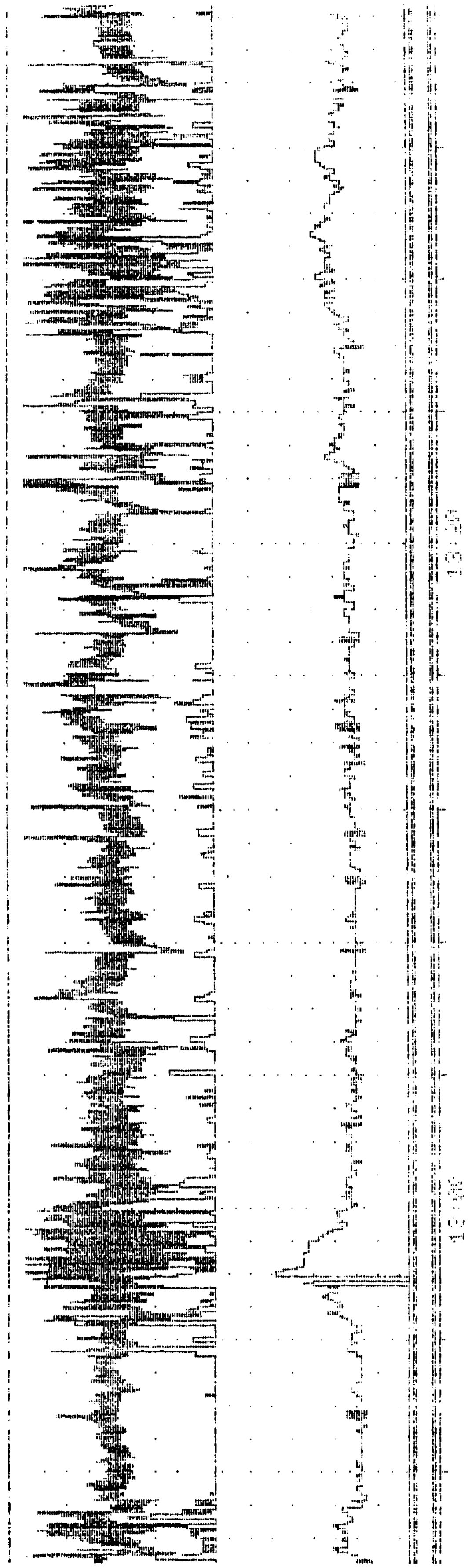


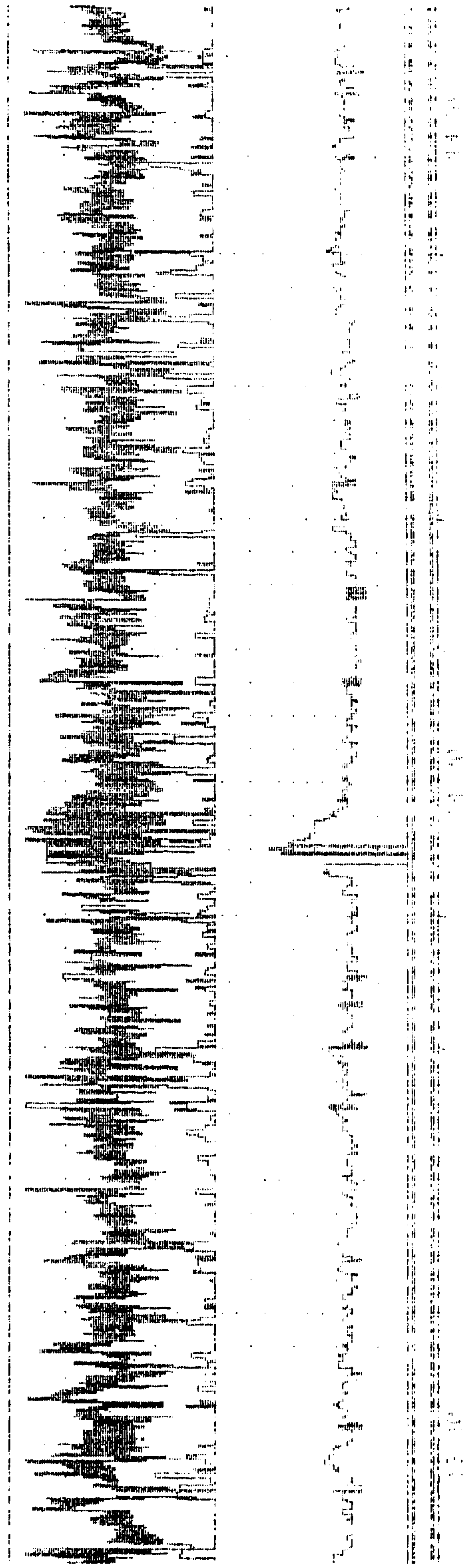


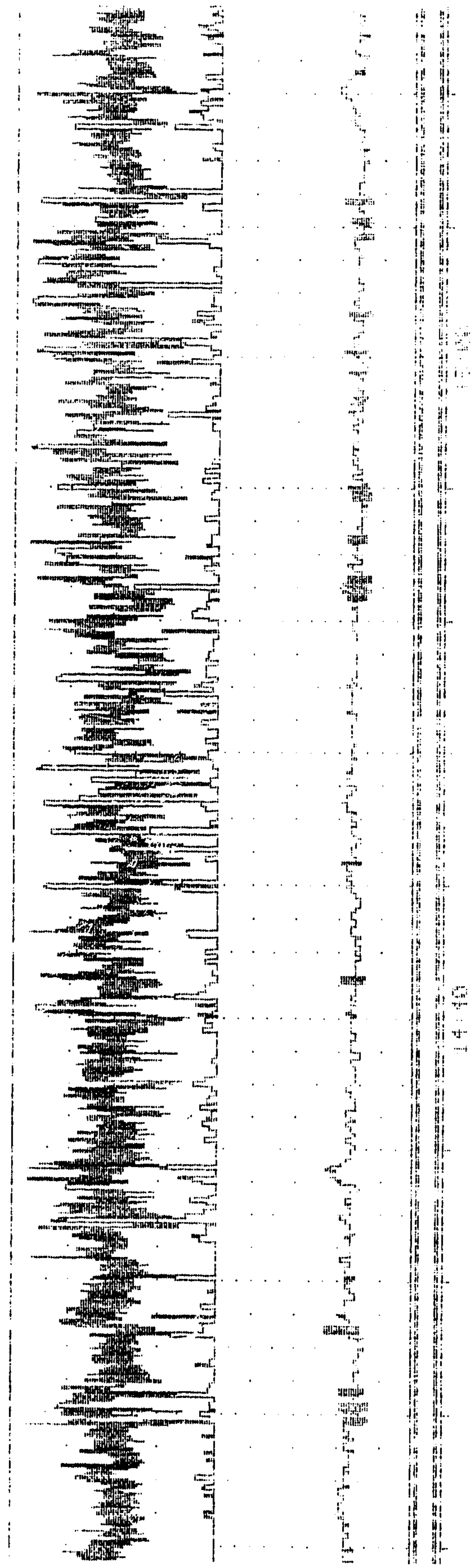








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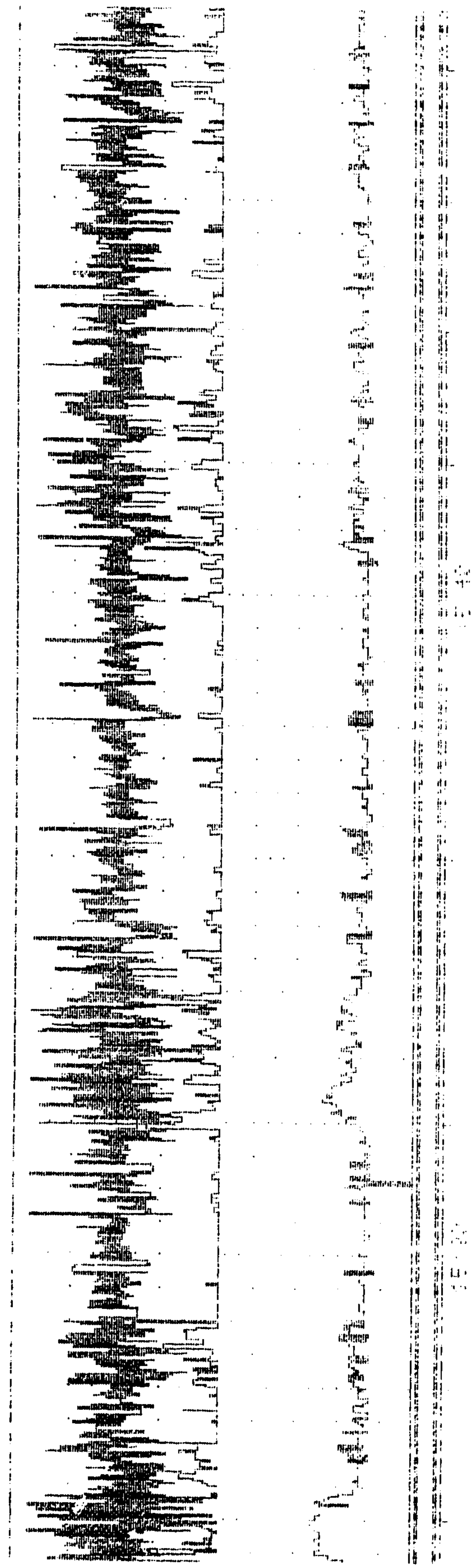
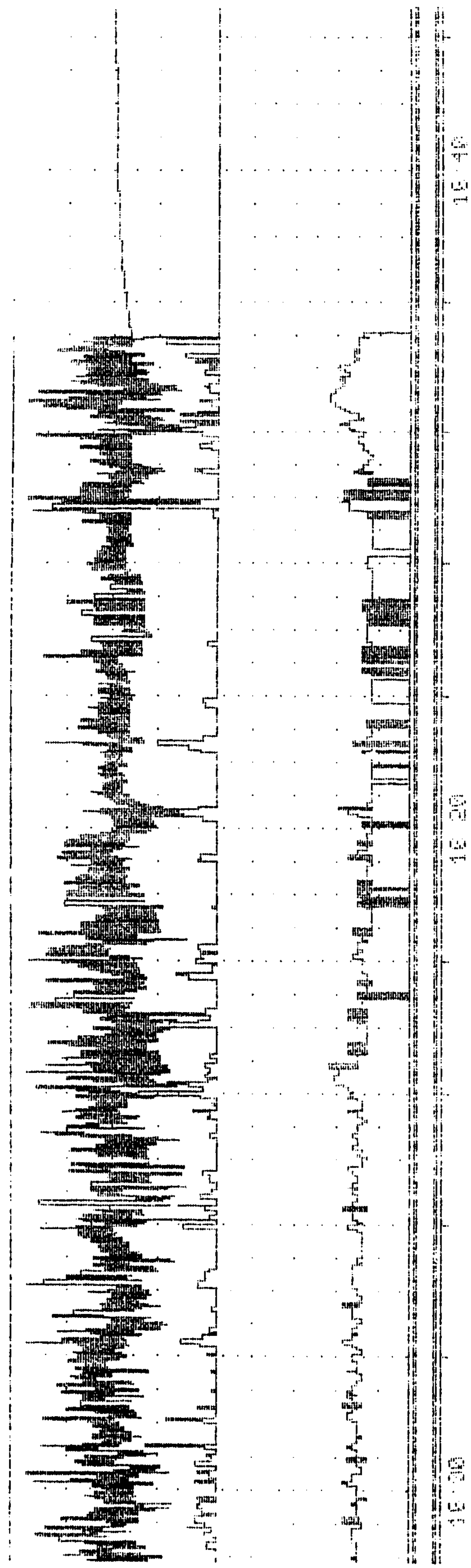




Appendix C

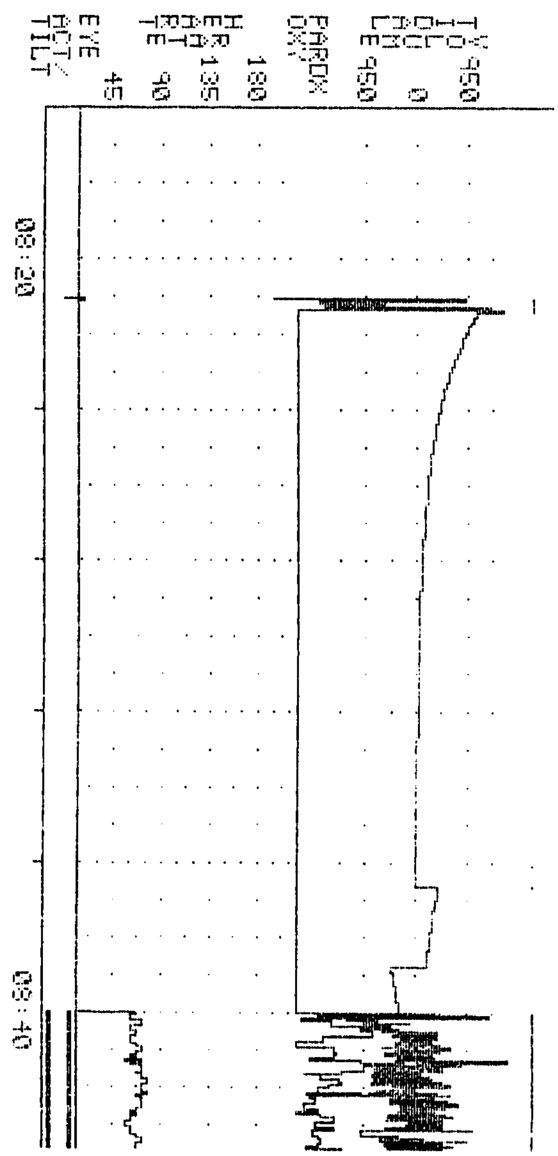
Patients Name : ::

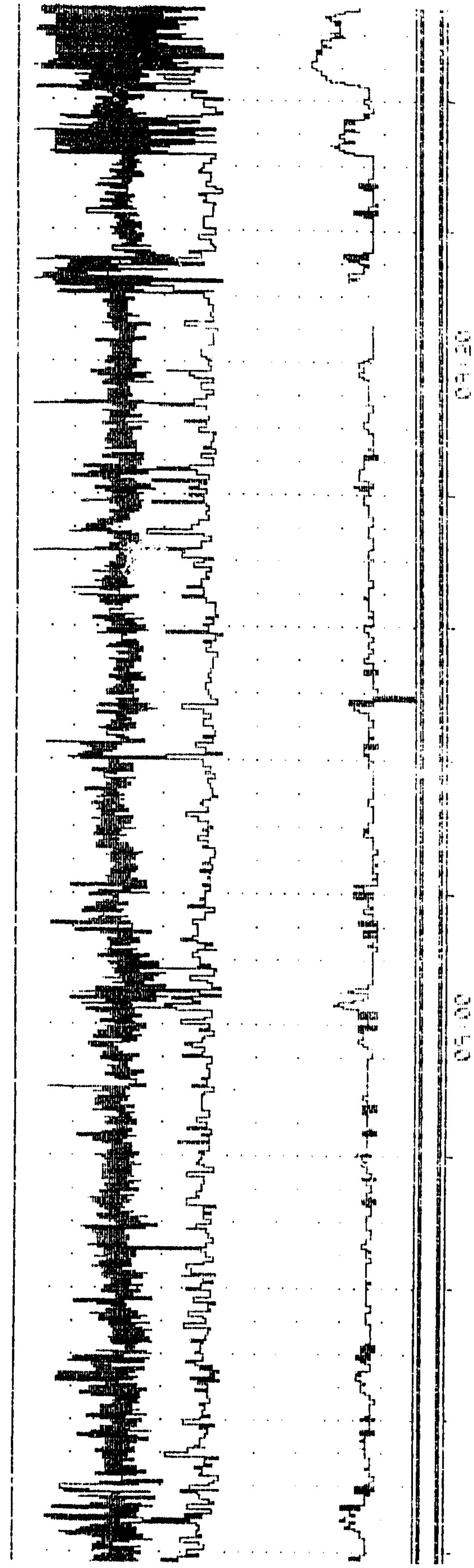
Patient Id :MILITARY

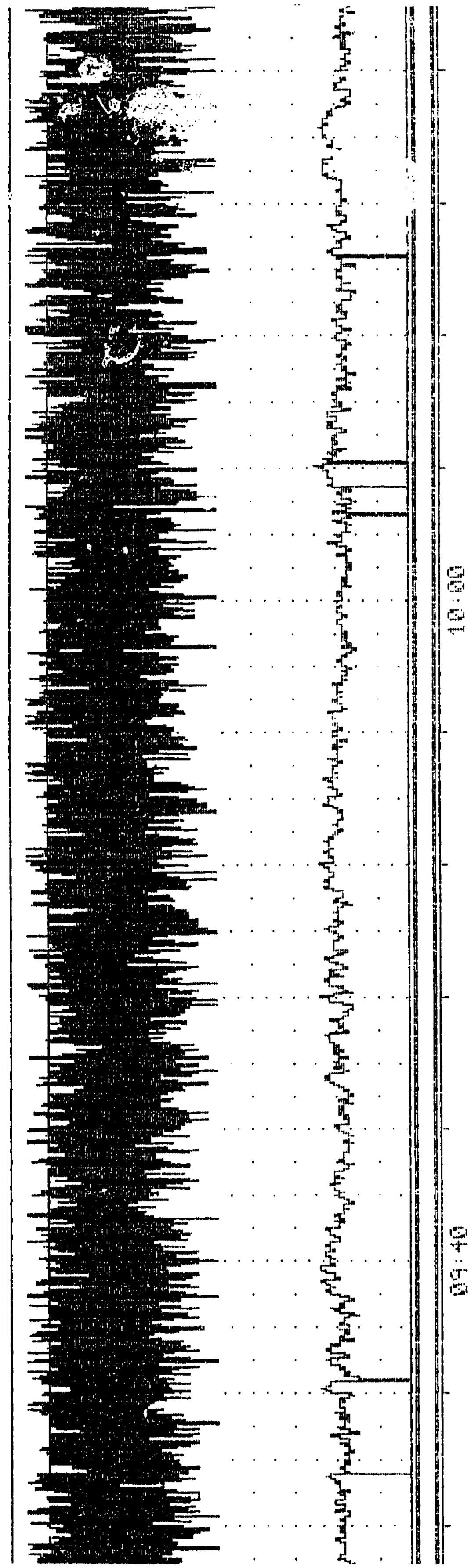
Recording Date : 051589

Age : 25

Weight : 170



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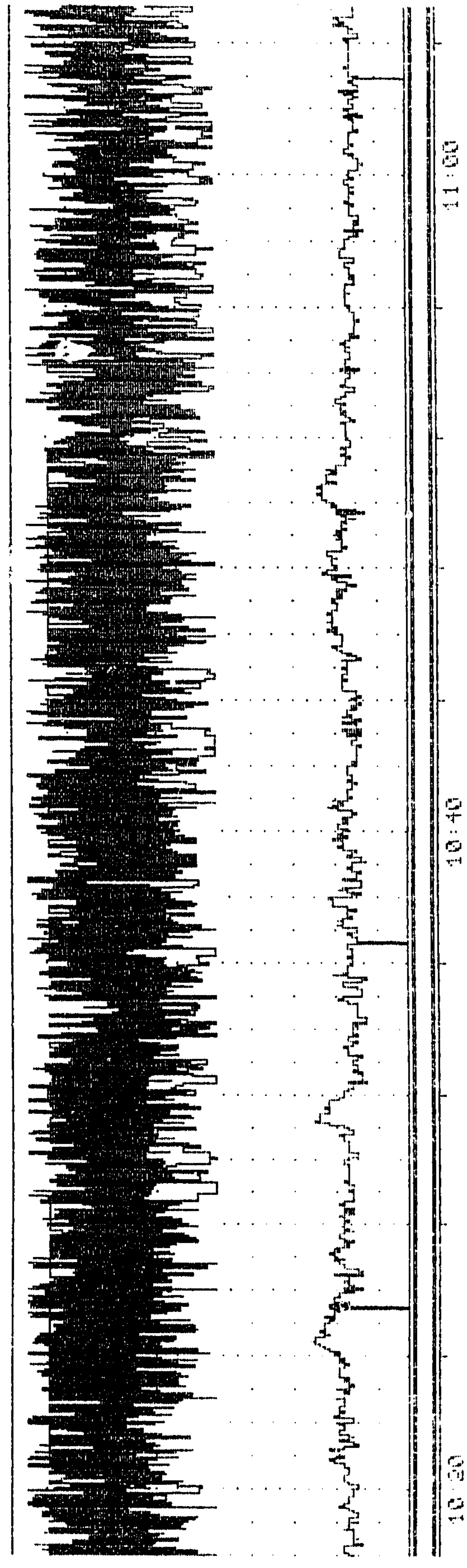
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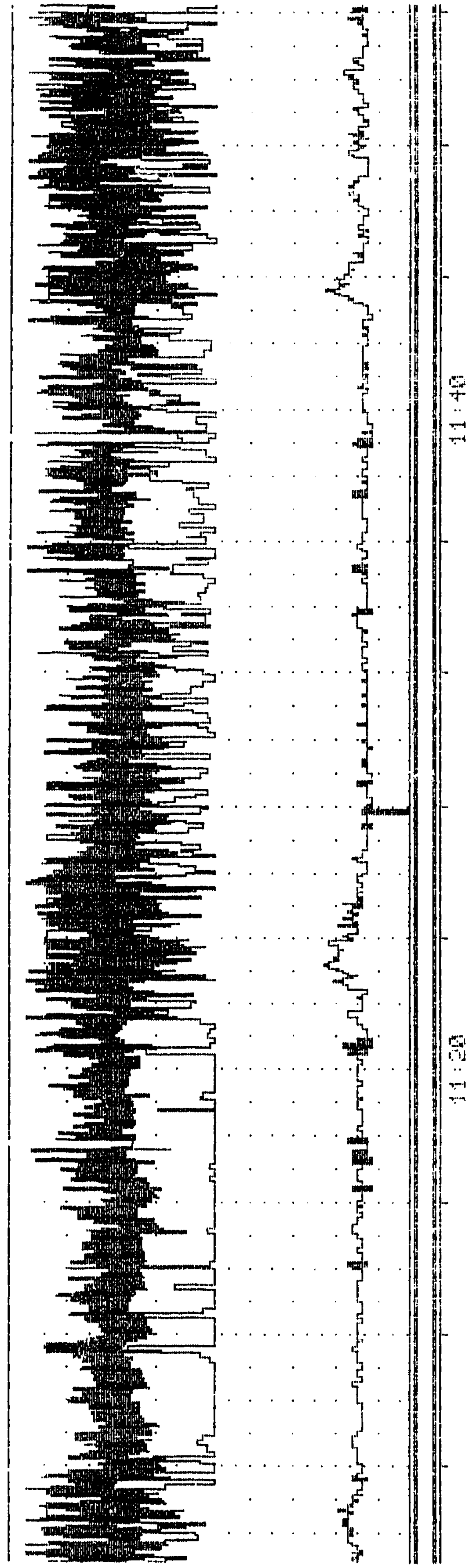
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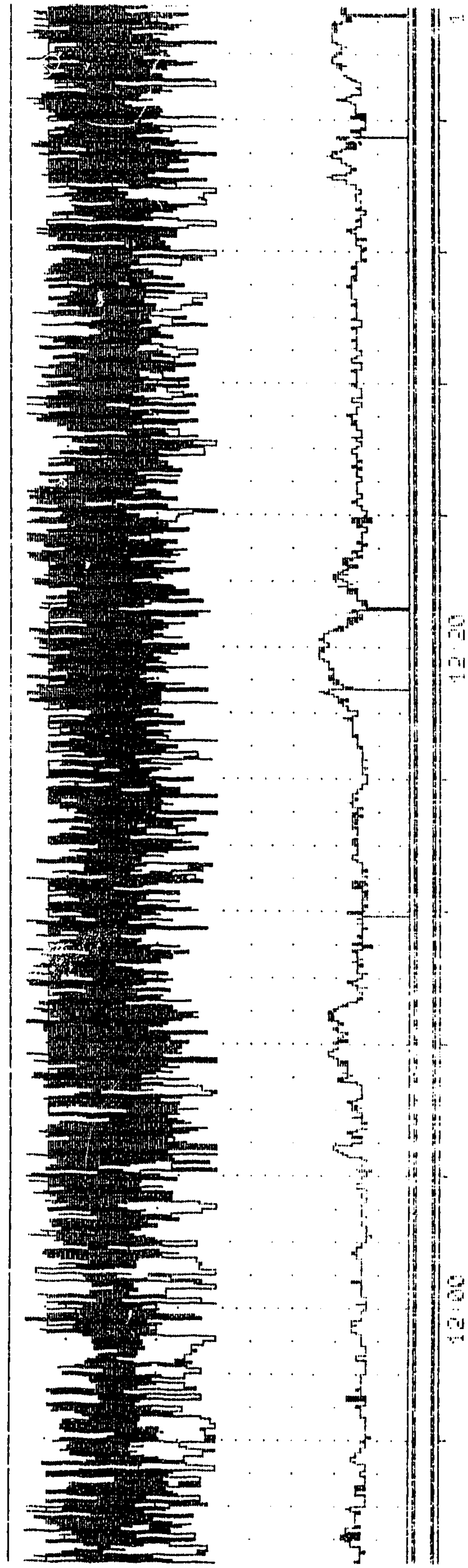
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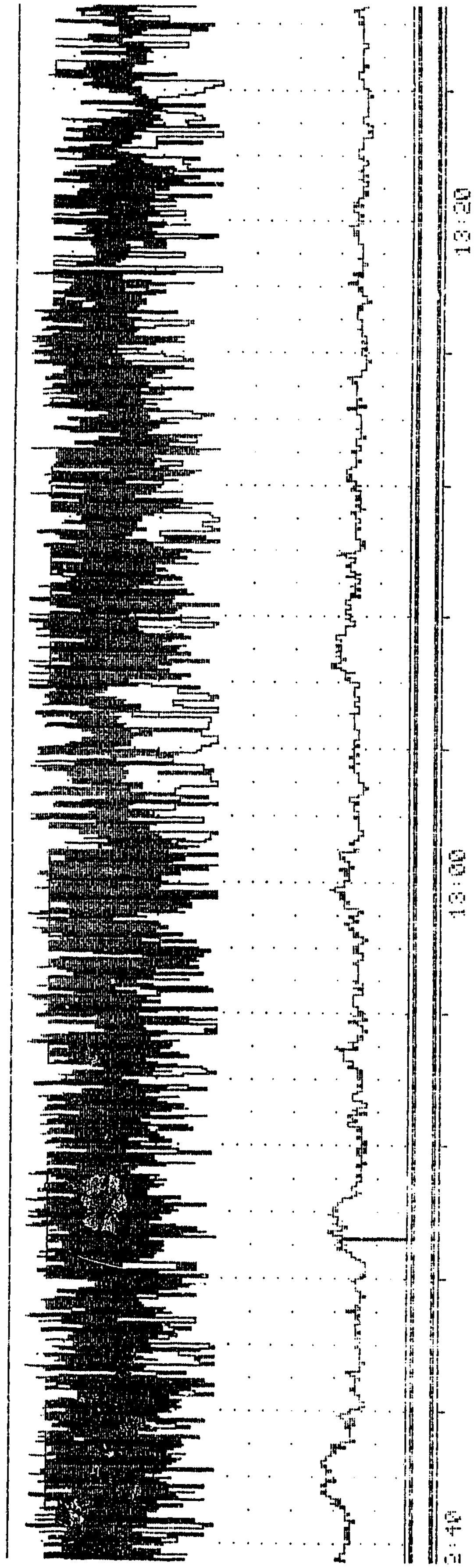
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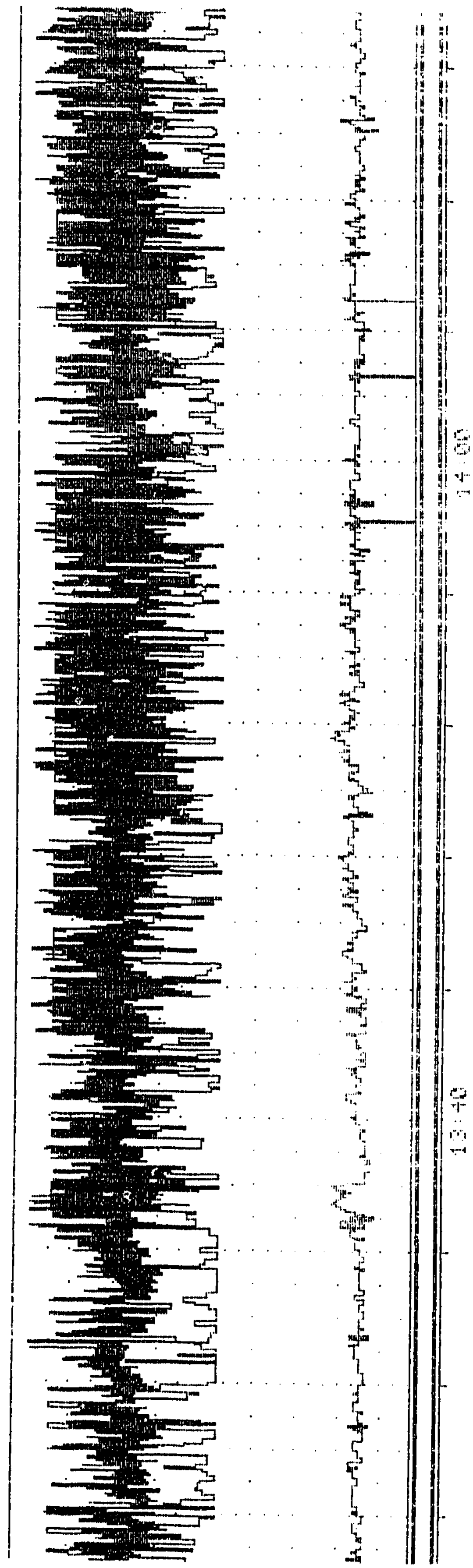
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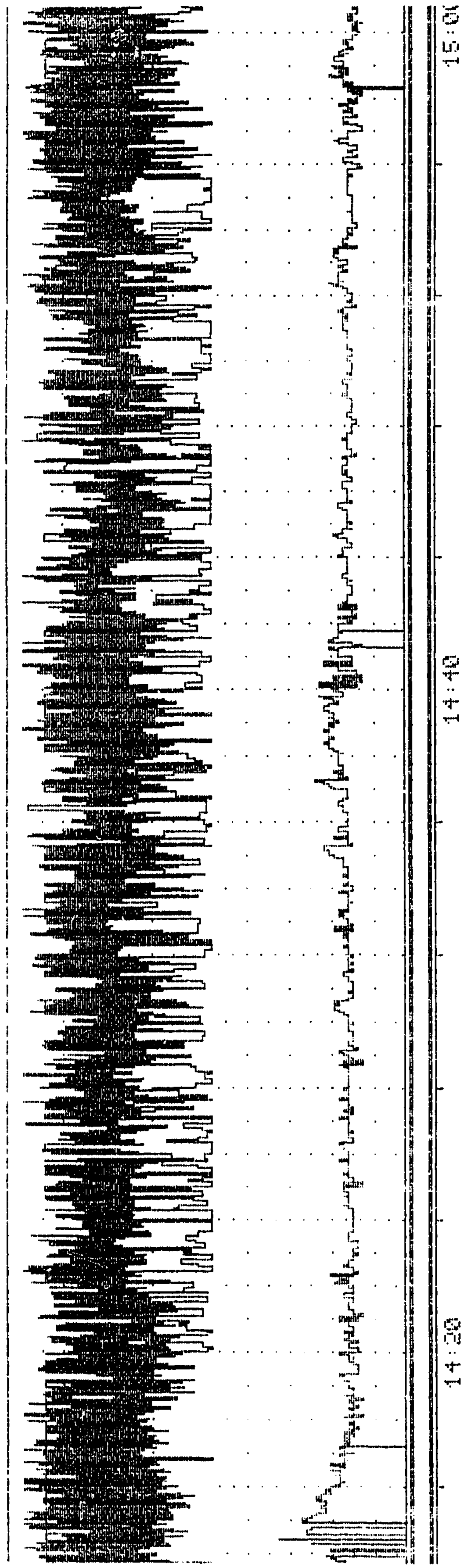
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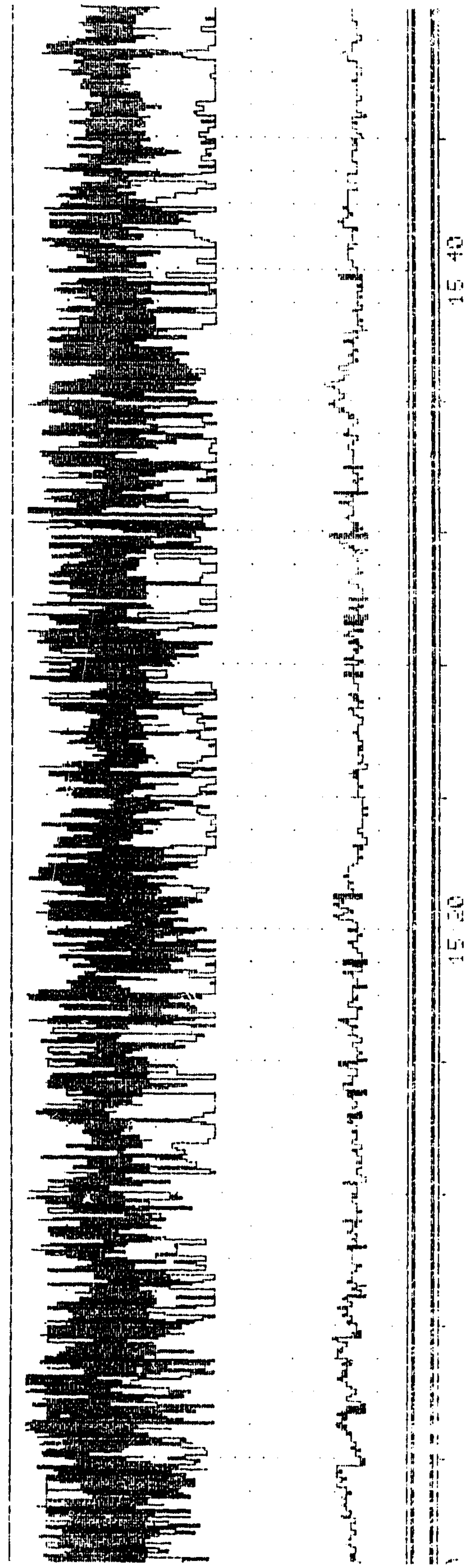
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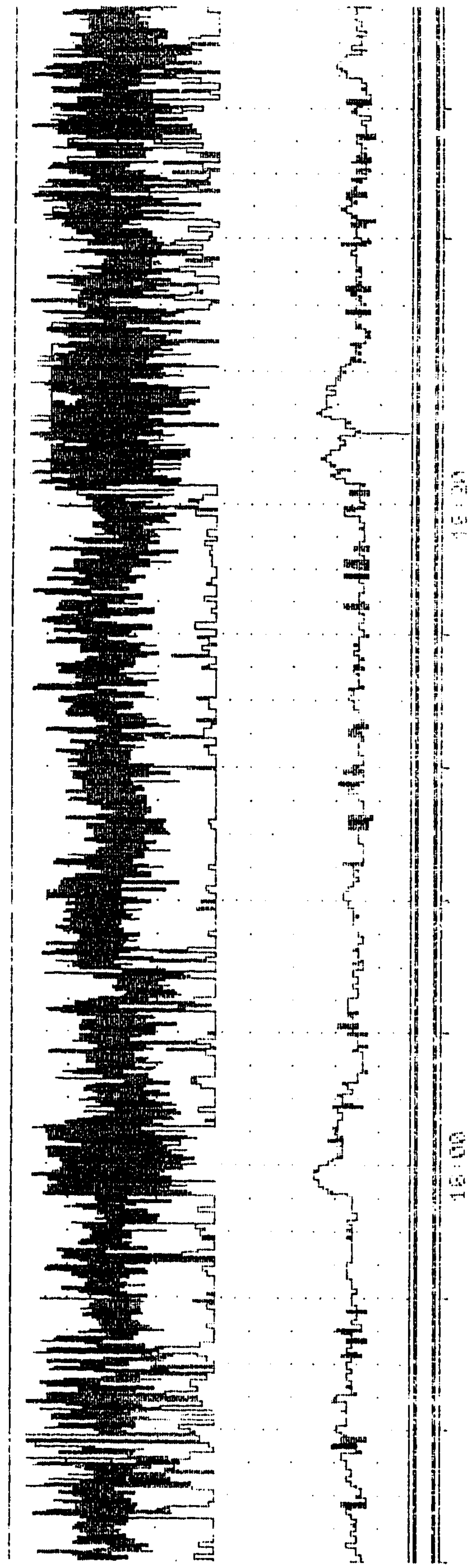
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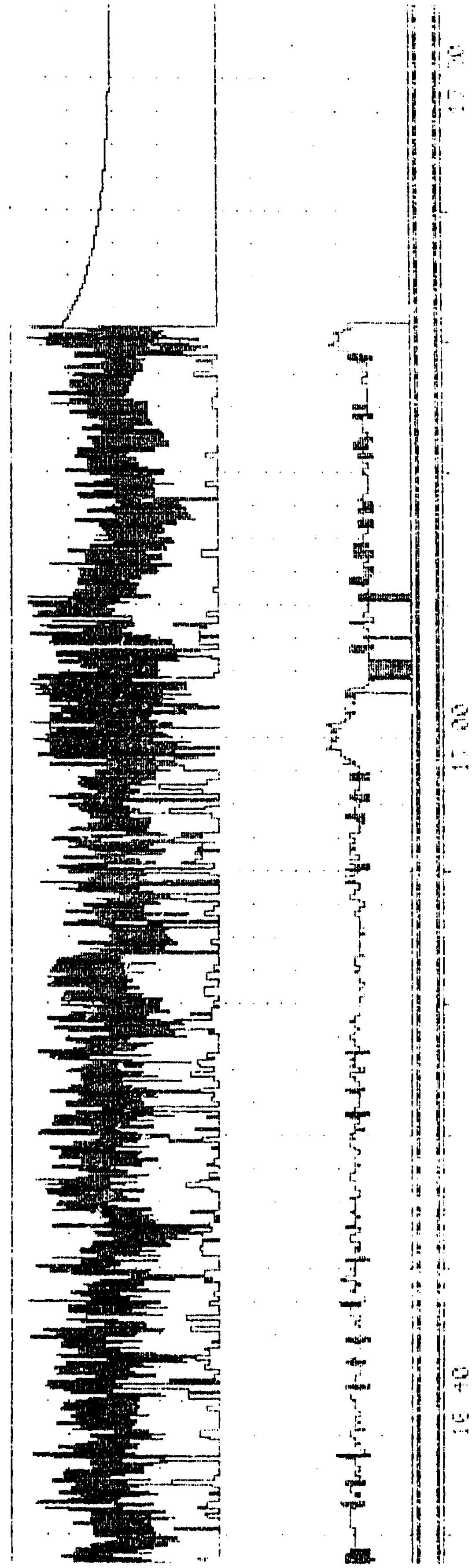


Appendix D

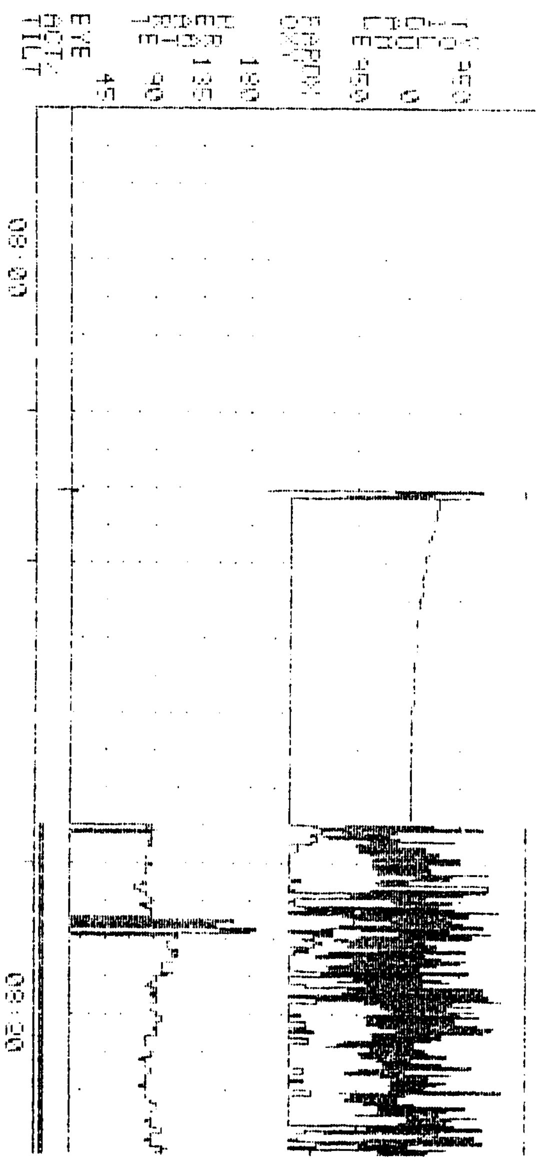
Patients Name :

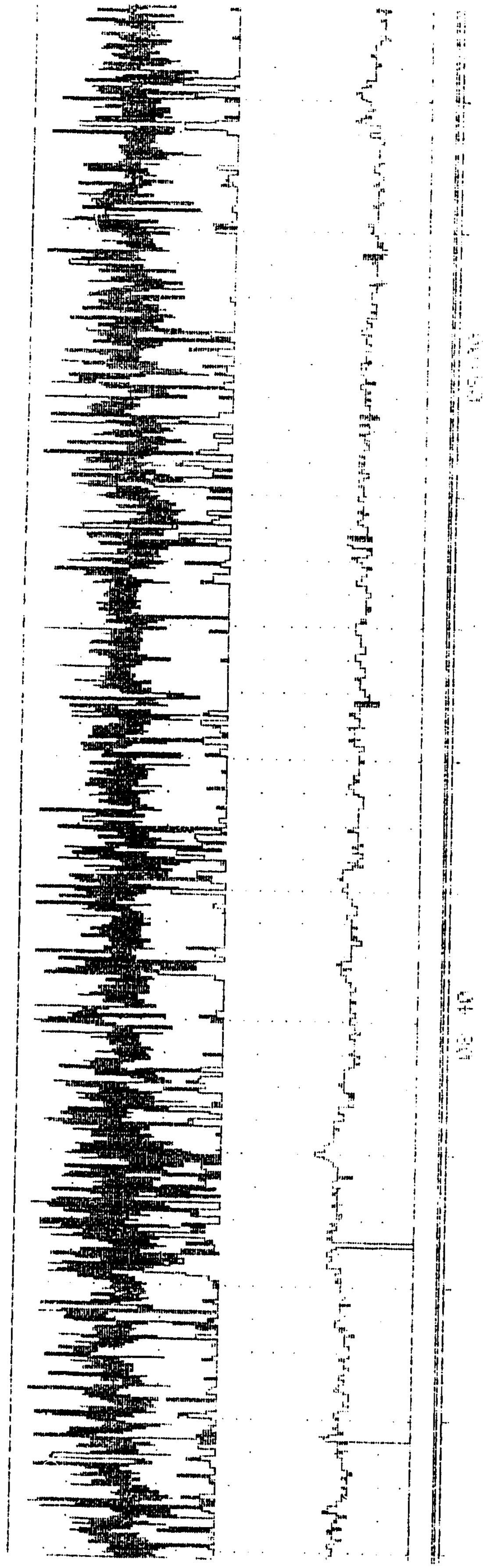
Patient Id :MILITARY

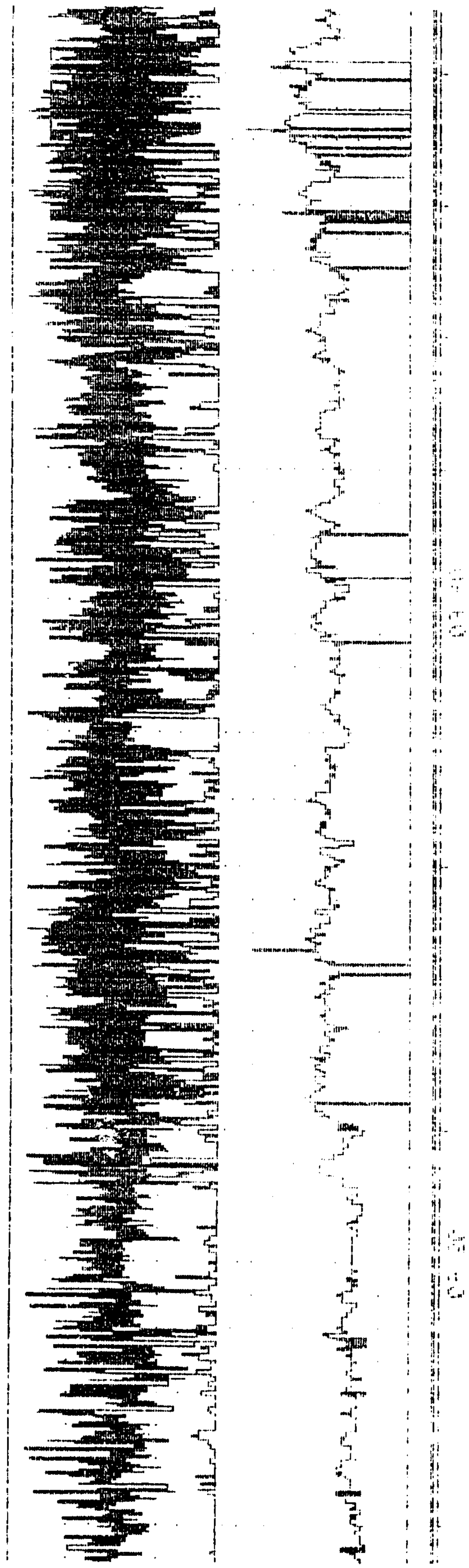
Recording Date : 051589

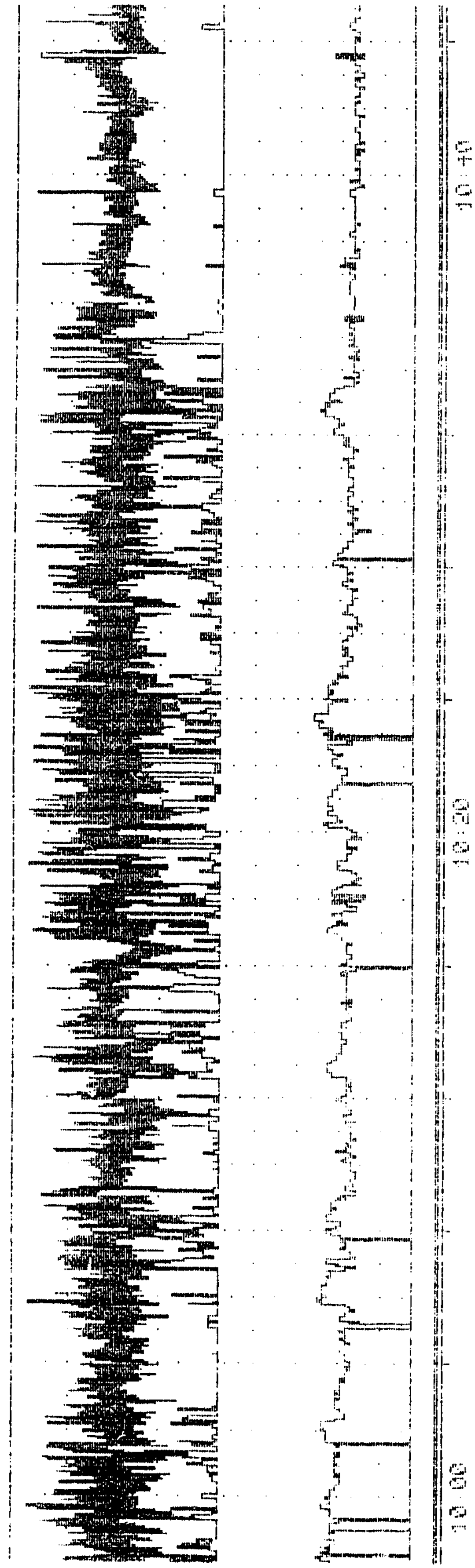
Age : 28

Weight : 165





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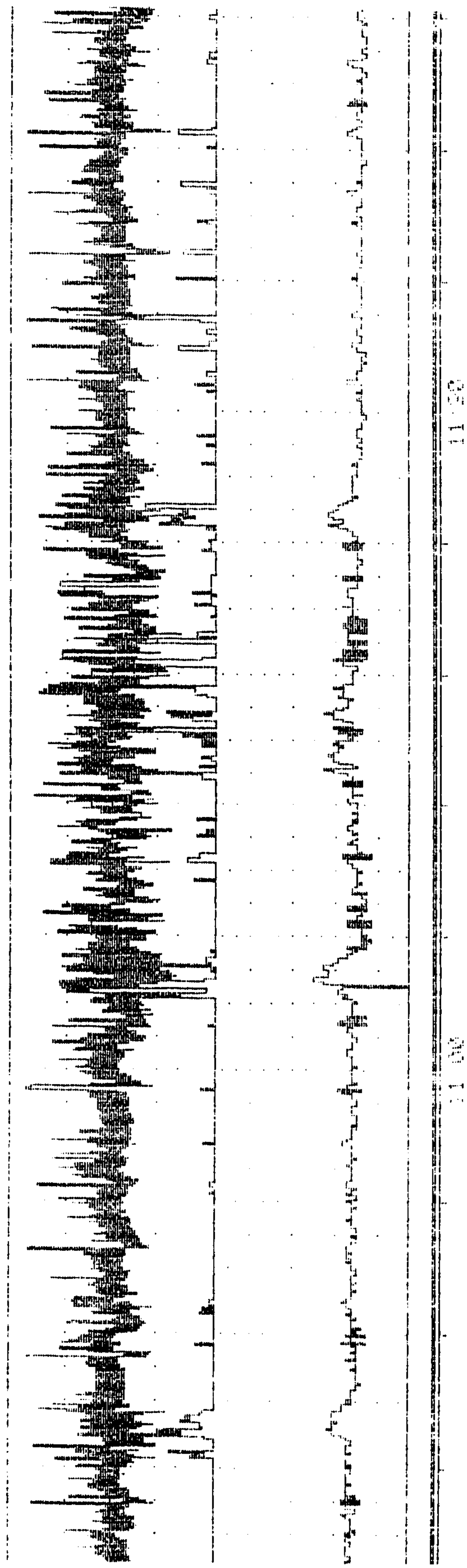

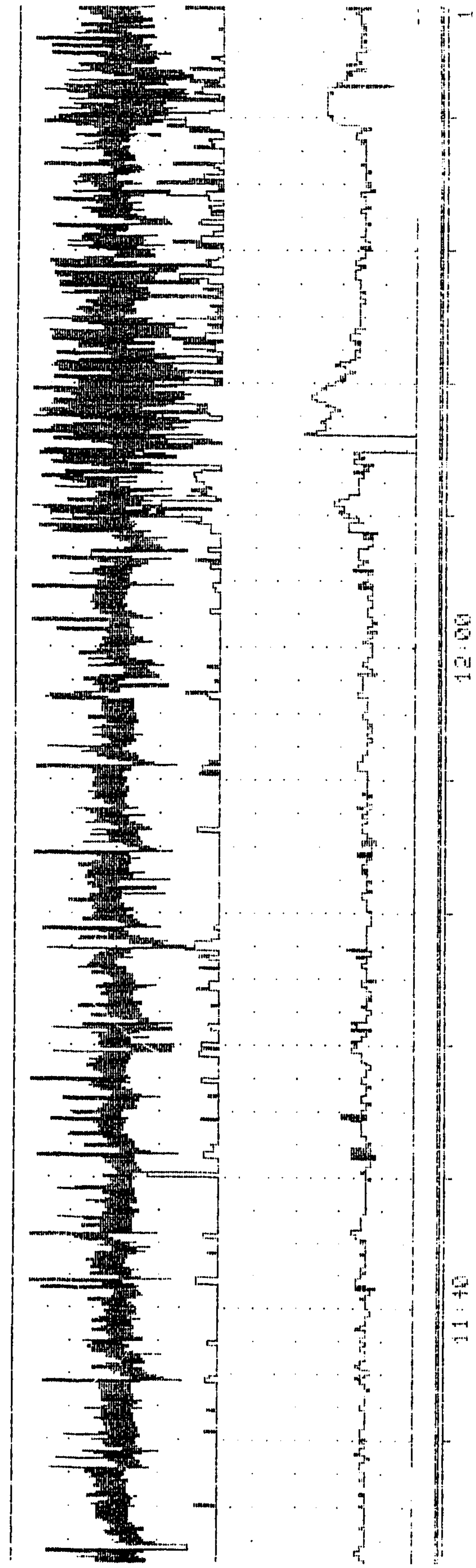
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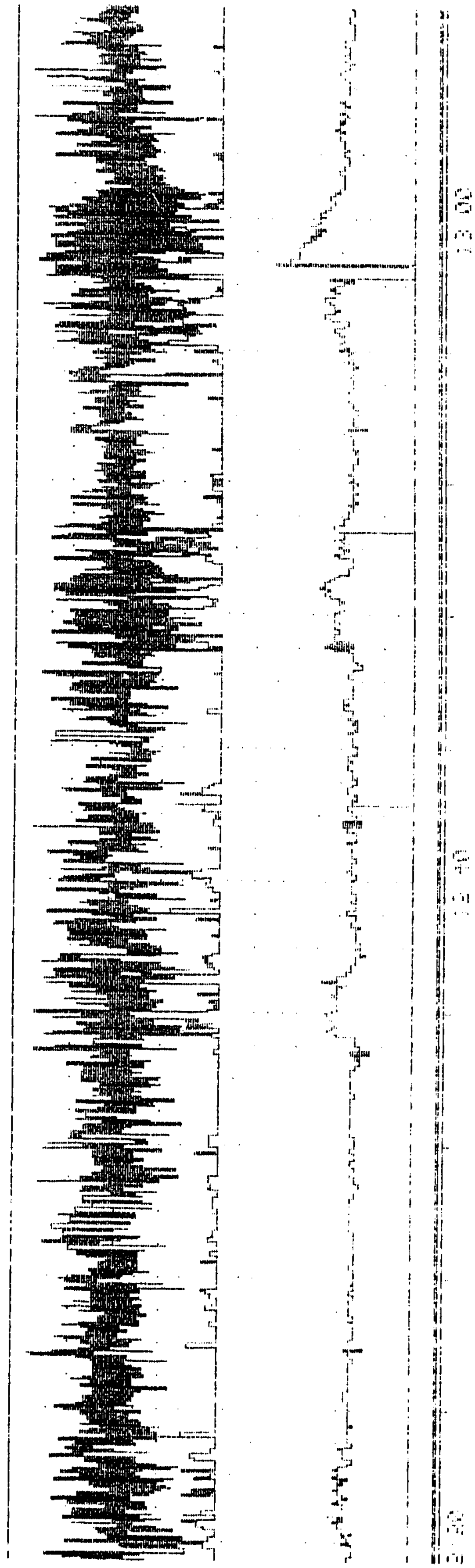

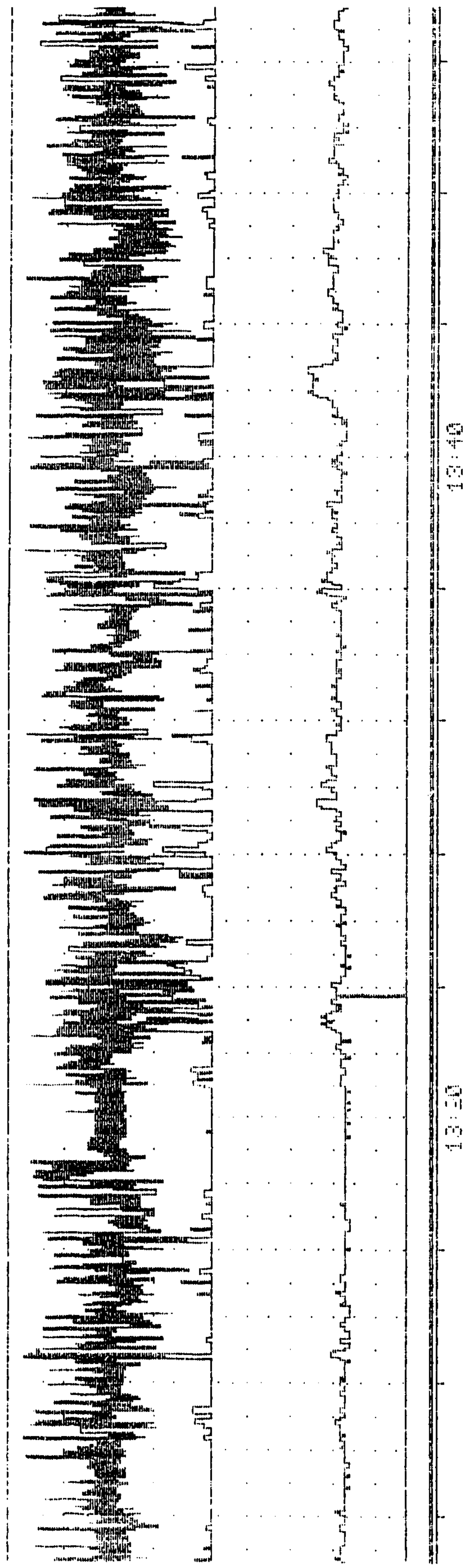
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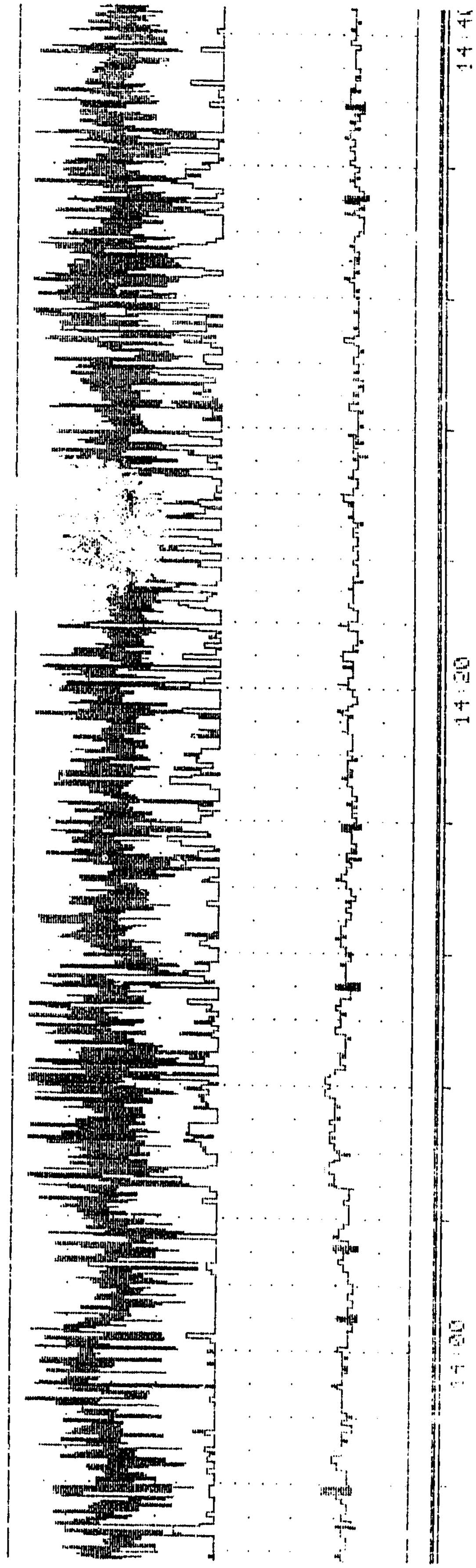
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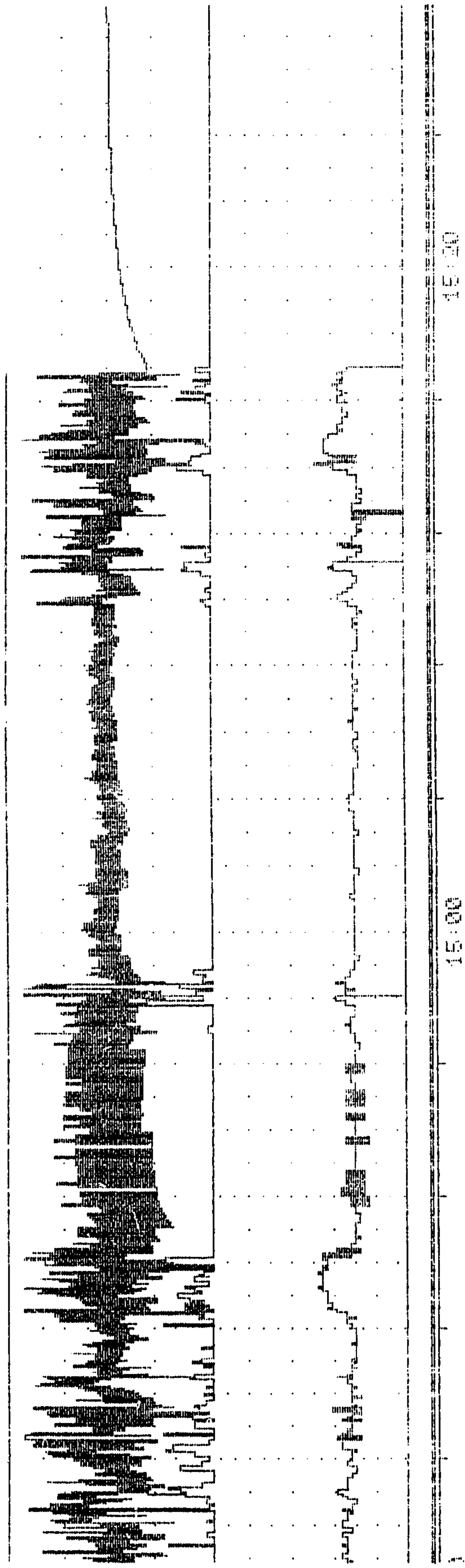
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